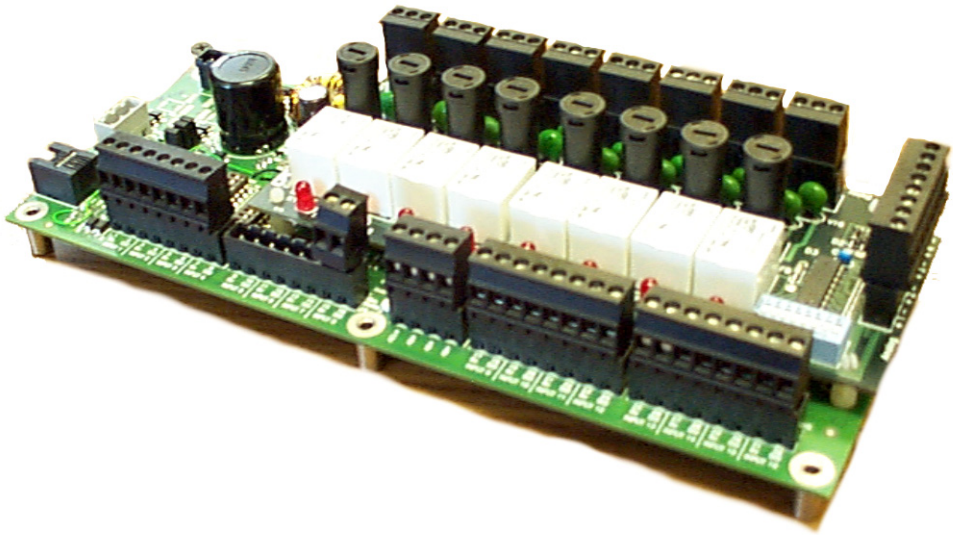
026-1722 Rev 4 03-JUN-2010

MultiFlex PAK Compressor/ Condenser Control Board User's Guide



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READ ALL INSTRUCTIONS CAREFULLY

If the equipment is not used in the manner specified by the manufacturer, the protection provided by the equipment may be impaired.

SAVE THIS INSTRUCTION MANUAL

This instruction manual contains important operating instructions for the MultiFlex PAK boards.

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1 Overview of the Multi-Flex Product Line

The MultiFlex line of control system boards provides a wide variety of input, output, and smart control solutions, all of which are based on a single universal hardware platform. The board design uses flash-uploadable firmware and plug-in expansion boards to configure the base platform board and apply it for use as an input board, relay output board, analog output board, or a combination I/O board.

1.1. MultiFlex PAK

The PAK is a distributed pack controller that controls compressors and condenser fans. The PAK can control up to 16 compressors, controlled in up to 8 compressor groups.

The PAK can control up to 4 condenser fan groups containing up to 8 total condenser fans. The PAK condenser control strategy is sequential TD control with setpoint/deadband using ON and OFF delays. The PAK supports use of both single-speed fan stages and VS fans.

1.1.1. Hardware

The MultiFlex PAK boards consist of two circuit boards: a bottom layer with 16 combination digital/analog inputs, and a plug-in top layer which contains a combination of 8 relay outputs and 4 analog DC voltage outputs, which can be used as digital or analog outputs.

The communication interface is RS485 I/O using the Standard Extended Address Form for CPC Distributed Controllers. Currently, the PAK is designed to interface with the CPC E2 RX controller, and the previous generation refrigeration controller, the Einstein RX.

2 Mounting and Powering

The MultiFlex boards are usually installed by the refrigeration or building equipment manufacturer. Therefore, the installer need only make the necessary connections between the boards and the site controller(s).

In some instances, an installer may be required to mount an I/O board. There are no restrictions on the location of these boards; however, for ease of network configuration, it is recommended that the boards be located adjacent to the E2. I/O boards may be mounted without an enclosure, but they should be mounted in a location that is not easily accessible to avoid tampering or damage.

2.1. Snap-Track Installation

MultiFlex boards not supplied in a custom panel or other enclosure are supplied with a snap-track for easy installation. The insulation sheet and I/O board must be removed from the track before the track is mounted. The snap-track is mounted using the 0.1875” mounting slots. ***Figure 2-1*** shows this installation procedure.

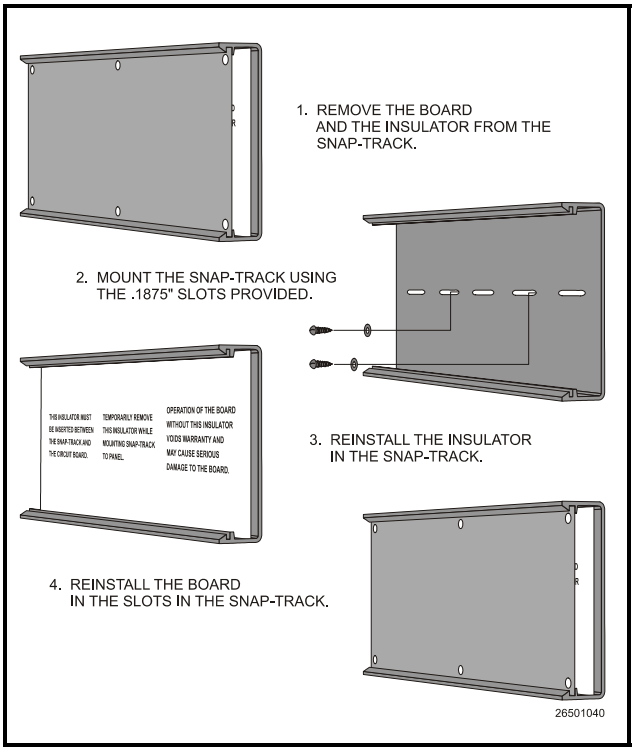
1. REMOVE THE BOARD AND THE INSULATOR FROM THE SNAP-TRACK.
2. MOUNT THE SNAP-TRACK USING THE .1875" SLOTS PROVIDED.
THIS INSULATOR MUST BE INSERTED BETWEEN THE SNAP-TRACK AND THE CIRCUIT BOARD.
TEMPORARILY REMOVE THIS INSULATOR WHILE MOUNTING SNAP-TRACK TO PANEL.
OPERATION OF THE BOARD WITHOUT THIS INSULATOR VOIDS WARRANTY AND MAY CAUSE SERIOUS DAMAGE TO THE BOARD.
3. REINSTALL THE INSULATOR IN THE SNAP-TRACK.
4. REINSTALL THE BOARD IN THE SLOTS IN THE SNAP-TRACK.
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Figure 2-1 *- MultiFlex Snap-Track Mounting*

Figure 2-2 provides mounting dimensions for the MultiFlex board.

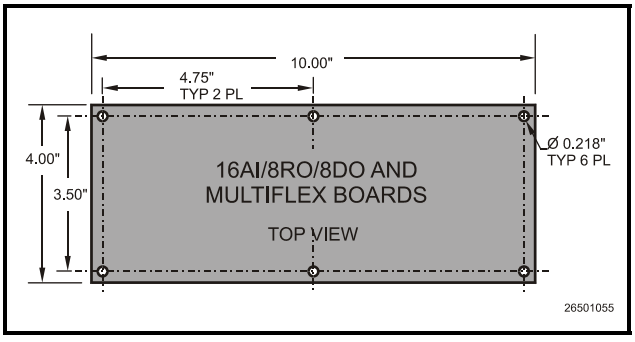


Figure 2-2 *- MultiFlex Board Dimensions*

2.2. The Plug-In Output Board

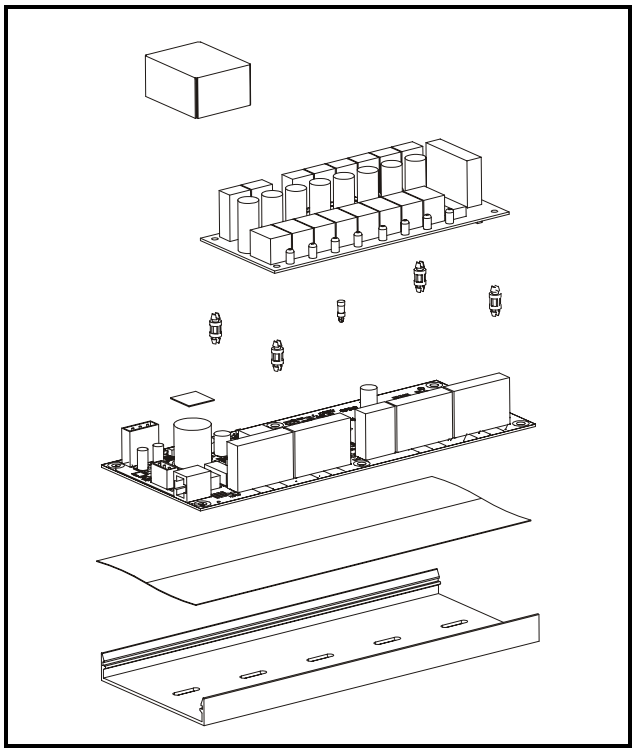


Figure 2-3 *- Exploded View -- MultiFlex Combination I/O Board*

All MultiFlex boards except the MultiFlex 16 have output sub-boards that plug in to the top of the base board. These boards are shipped with the output board pre-installed on the board using stand-offs, so no additional hardware setup should be necessary.

The additional board makes the MultiFlex combination boards considerably taller than the MultiFlex 16 and all previous-generation CPC I/O boards. If you will be mounting these boards in an enclosure, the board will need at least 2.5" of clearance between the base board and the panel door.

2.3. Powering the MultiFlex

All models of MultiFlex require a 24VAC Class 2 input power source. The MultiFlex PAK requires the power source to be ***center-tapped.***

CPC supplies a wide variety of 24VAC transformers with varying sizes and either with or without center taps. ***Table 2-1*** shows the transformer sizes and whether they are center-tapped or non-center-tapped.

Xformer P/N	VA Rating	Primary Voltage	Center Tap?
640-0041	50 VA	110 VAC	No
640-0042	50 VA	220 VAC	No
640-0056	56 VA	Multi-tap (120/208/240 VAC)	Yes
640-0050	75 VA	110 VAC	No
640-0045	75 VA	220 VAC	No
640-0080	80 VA	Multi-tap (120/208/240 VAC)	Yes

Table 2-1 *- Transformers Compatible with MultiFlex Board*

2.3.1. Choosing Transformer Sizes

In most site installations, a single transformer will power multiple devices. Choose a transformer with a VA rating large enough to power all devices that will be attached to it. ***Table 2-2*** gives the VA ratings of the MultiFlex board products. Refer to your site controller's manual for VA ratings of the other I/O boards that may be powered by one of these transformers.

Unit	VA	VAC	Center tapped?
MultiFlex PAK, CUB, RTU, and RCB	15	24	NO
MultiFlex 16	6	24	Yes
MultiFlex 88, 88AO, 168, 168AO and 168DO	15	24	NO

Table 2-2 *- Device Power Requirements*

2.3.2. MultiFlex Combination Input/ Output Board Power Wiring

The MultiFlex PAK boards do not use a center tap. Instead, the 0V terminal on the board should be connected to a separate Earth ground.

Important! The rules that must be followed when connecting a MultiFlex PAK board to a transformer are different depending on whether you have a "new style" MultiFlex board with an isolated power supply (all MultiFlex boards shipped after November 1, 2002) or an "old style" MultiFlex board (all MultiFlex boards shipped before November 1, 2002).

A new-style MultiFlex PAK board has a green power LED located next to the 24VAC connection terminal in the upper right corner of the circuit board (see ***Figure 2-4*** for reference).

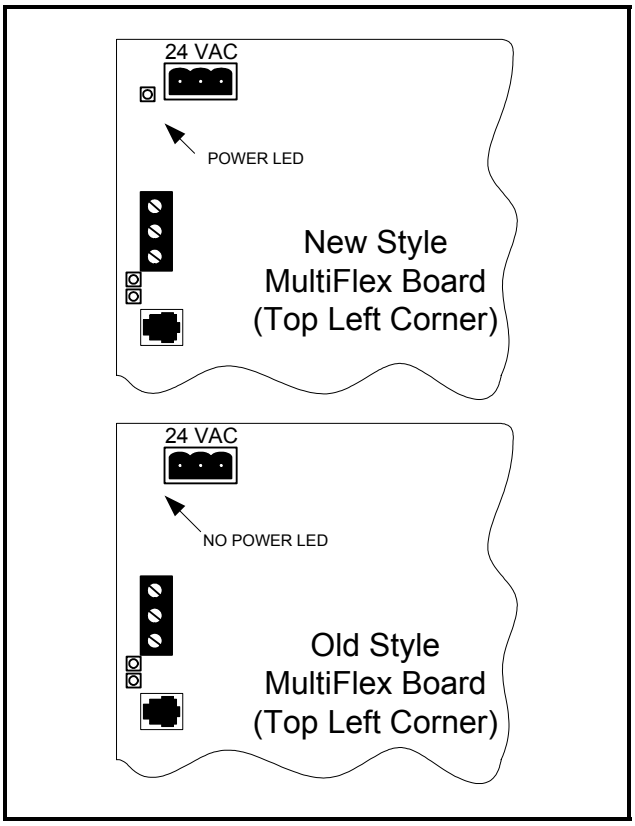


Figure 2-4 *- New-Style vs. Old-Style MultiFlex Board*

If there is a power LED next to the connector, your MultiFlex is a **new-style MultiFlex --** refer to **Section 2.3.2.1.,** *New-Style MultiFlex Combination I/O Boards (with Isolated Power Supply)* for power wiring instructions.

If there is no power LED next to the connector, your MultiFlex is an **old-style MultiFlex** -- refer to **Section 2.3.2.2.,** *Old-Style MultiFlex Combination I/O Boards (No Isolated Power Supply)* for power wiring instructions.

2.3.2.1. New-Style MultiFlex Combination I/O Boards (with Isolated Power Supply)

The new-style MultiFlex board can be connected to any of the center-tapped transformers mentioned in ***Table 2-2***, provided the 0V terminal of the board is connected to an Earth ground.

A center-tapped transformer may power both center-tapped and non-center-tapped boards at the same time, as long as **none of the non-center-tapped MultiFlex boards are old-style MultiFlex boards.** If an old-style MultiFlex shares the same center-tapped transformer as a device that uses the center tap, boards on the network will be damaged. ***Figure 2-5*** shows how to wire a non-center tapped device to a center-tapped transformer.

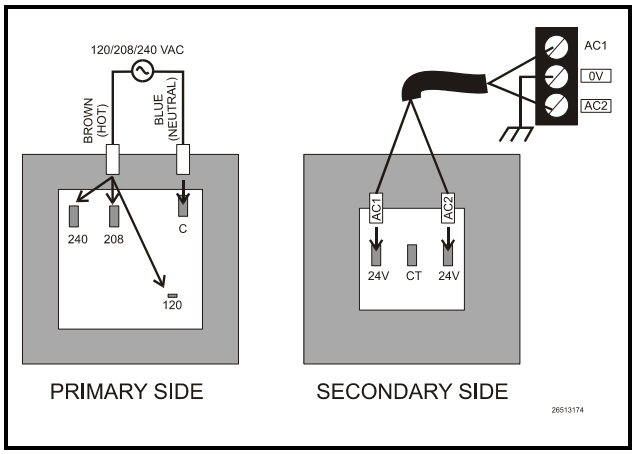


Figure 2-5 *- Wiring Non-Center Tapped MultiFlex Boards to Transformers With a Center Tap*

In addition, the MultiFlex combination boards can be powered by one of the 50VA or 75VA non-center-tapped transformers listed in Table 2-1 on page 3. ***Figure 2-6*** shows how to wire the transformers to the MultiFlex boards.

You may also tie one side of the secondary (but not BOTH sides) or the center tap to an earth ground, provided none of the boards powered by the same transformer are old-style MultiFlex boards (see **Section 2.3.2.2.**).

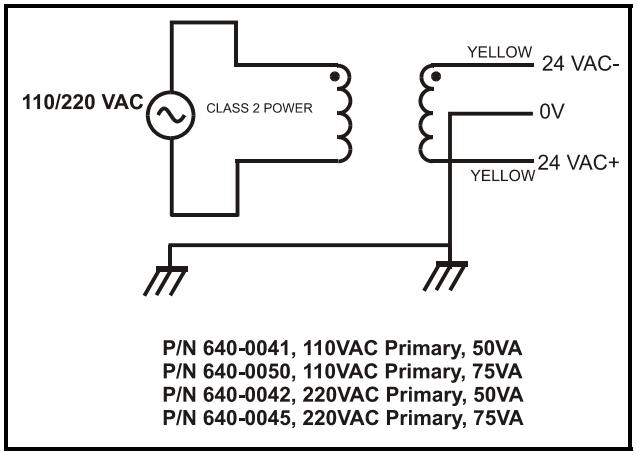


Figure 2-6 *- Non-Center-Tapped Transformer Wiring*

All wire connections to earth ground should be less than six (6) inches long and use a wire gauge of at least 14AWG.

2.3.2.2. Old-Style MultiFlex Combination I/O Boards (No Isolated Power Supply)

Like the new-style MultiFlex board, the old-style MultiFlex board can be connected to any of the center-tapped transformers mentioned in ***Table 2-2***, provided you follow the following three rules:

Rule 1: Ground the 0V terminal on the old-style MultiFlex board to an Earth ground.

Do not connect the center tap of the transformer to the 0V terminal.

Rule 2: Do not power an old-style MultiFlex non-center-tapped board with a transformer that is also powering a center-tapped device.

This means you cannot connect an old-style MultiFlex non-center tapped board to a transformer that is powering a MultiFlex 16, 16AI, 8RO, 4AO, 8DO, a Gateway board, or any previous generation CPC board that uses center-tapped power. Doing so will destroy the MultiFlex board.

Rule 3: The secondary of the transformer must not be grounded on any side.

Verify that neither side of the transformer secondary is connected to earth ground before powering the old-style MultiFlex board. A grounded secondary will damage the MultiFlex board.

In addition, the old-style MultiFlex combination boards can be powered by one of the 50VA or 75VA non-center-tapped transformers listed in Table 2-1 on page 3. ***Figure 2-6*** shows how to wire the transformers to the MultiFlex boards.

2.3.3. Wire Types and Maximum Distances

For powering I/O boards, use only the listed wire types from ***Table 2-3***. Three-conductor non-shielded cables are the recommended wire for connecting between the center tapped transformer and the I/O boards. Shielded cable should not be used for power wiring. The center tap should be wired with the third conductor to earth ground at the transformer.

Each MultiFlex board should have its 0V terminal taken to a short, solid earth ground.

Power Wiring Types	
14 AWG	Belden 9495 or equivalent
18 AWG	Belden 9493 or equivalent

Table 2-3 - *Power Wiring Types*

The wire length from the transformer and the number of boards connected to the same wire determines the type wire gauge used. In most cases, the distance between the I/O boards and the transformer that supplies power to them is not enough to be concerned with. But it is very important not exceed this maximum wire length or the boards will malfunction.

Use these formulas to determine if the wire gauge you are using fits within specification:

14 AWG:
Feet = 0.40/(VA/24) x 0.005
18 AWG:
Feet = 0.40/(VA/24) x 0.013
(VA is the total VA rating of the I/O boards)
For example, if you had an 80 VA load:
14 AWG: 24 ft. (rounded down)
18 AWG: 9 ft.

Figure 2-7 - *Power Wire Lengths*

3 The I/O Network

All MultiFlex PAK boards and controllers use an RS485 network connection to communicate with E2 site controllers. Technicians who are familiar with CPC's previous generation 16AI, 8IO, and ARTC boards will find the network setup procedure for the MultiFlex boards to be very much the same.

3.1. Wiring Types

CPC specifies all RS485 I/O and MODBUS wiring used by the E2 must be Belden 8641 (24AWG, 300V, CPC P/N 135-8641); Belden 8761 (22 AWG, 300V not stocked by CPC); or a 600V-shielded 22AWG equivalent stocked by CPC (P/N 135-0600). These are two-connector shielded twisted pair cable that support a maximum daisy chain cable distance of 4000 feet (1219 m) between the E2 and the end device on the network.

Provided the cable can be routed away from noise generators and avoid running in parallel with high-voltage wire, any of the three specified cables will provide adequate shielding from external noise. For more instructions on best practices for minimizing noise, refer to publication ***026-1903, E2 Controller Wiring Practices,*** available in the Product Manuals section of the Emerson Retail Solutions website (*http://www.emersonretailsolutions.com/library*).

3.2. Daisy Chains

The RS485 Input/Output (I/O) network is wired in a daisy-chain configuration. In a daisy chain, boards are wired together in series with no branches or "star configurations," and the network is terminated at either end of the daisy chain.

A diagram of this network arrangement is shown in ***Figure 3-1***.

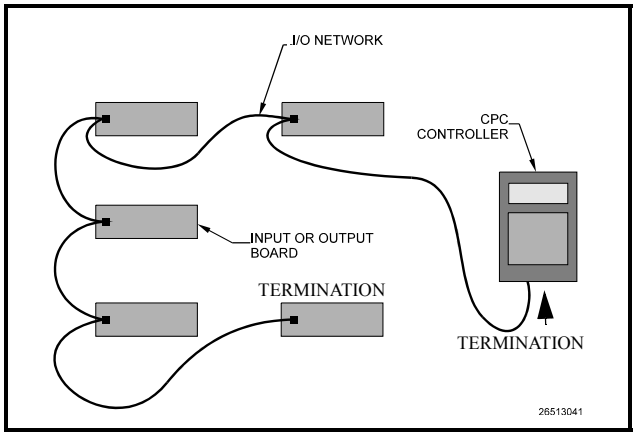


Figure 3-1 *- I/O Network Configurations*

3.2.1. Network ID Numbers

Each device on an RS485 segment has a network dip switch that must be used to assign the board a unique **network ID number**.

The network ID number makes a board unique from other boards on the network of the same type. This allows the site controller to find it and communicate with it.

Boards of the same type should be numbered in sequence, starting with one and continuing with two, three, etc.

3.2.1.1. Numbering the MultiFlex PAK

The network ID on the MultiFlex PAK is set using the first five dip switches on dip switch bank S3. Refer to ***Figure 3-2*** for dip switch setting instructions.

NOTE: The MultiFlex PAK may only be numbered up to 16, since E2 will only speak to a maximum of 16 PAK boards. A PAK numbered above 16 will be ignored.

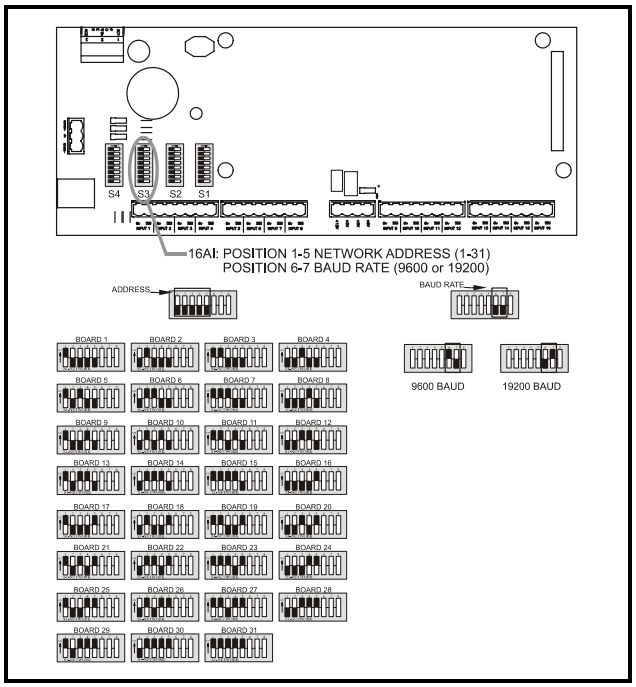


Figure 3-2 *- 16 Network ID and Baud Rate Switches*

3.2.2. Setting the Baud Rate

All I/O boards have dip switches that determine the baud rate at which they communicate. Currently, the baud rate dip switch in network components may be set at either 9600 or 19200 baud. Either may be used -- refer to your site controller's user manual for the baud rate recommendation (currently 9600 baud for both REFLECS and E2 controllers).

On all MultiFlex boards, switches 6 and 7 on S3 are used to set the baud rate. To communicate at 9600 baud, set switch #6 UP and #7 DOWN. For 19200 baud, set switch #6 DOWN and #7 UP. Refer to ***Figure 3-2*** for a visual look at how the switches must be set.

3.2.3. Setting the Terminating Resistance Jumpers

All MultiFlex boards and other RS485 devices have a set of terminating resistance jumpers (one jumper for each wire lead). These jumpers are labeled JP2, JP3, and JP4 on the MultiFlex board.

The purpose of the jumpers is to indicate the two ends, or termination points, of the segment. On a daisy chain, one device at the beginning and one device on the end must be terminated. On the MultiFlex, this is done by placing all three termination jumpers in the OUT (toward the left edge of the board) position. To unterminate a MultiFlex, these jumpers must be set to the IN (toward the center of the board) position. ***Figure 3-3*** shows the termination jumper settings for all MultiFlex boards.

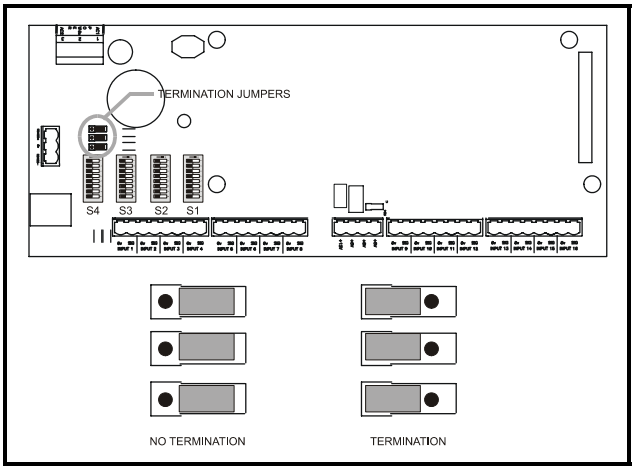


Figure 3-3 *- I/O Network Termination Jumper Settings*

4 I/O Board Input and Output Setup

4.1. The Inputs

The inputs on a MultiFlex board are compatible with a wide range of analog and digital sensors and transducers. In general, the inputs are capable of reading analog voltage signals in the range of 0V to +7VDC and dry-contact (no outside voltage) digital sensors and switches.

The specific types of input devices that must be used with MultiFlex is largely dependent on the site controller MultiFlex is connected to; refer to the site controller's user's manual for a full list of compatible sensors and specific sensor wiring instructions.

4.1.1. Input Types Supported by the MultiFlex PAK

Input Type	Description
Suct Xdcr	Pressure transducer measuring suction pressure
Disch Xdcr	Pressure transducer measuring discharge pressure
Amb Temp 1	Temperature sensor measuring outdoor air temperature
Amb Temp 2	Optional second ambient air temperature sensor. Will be combined with Amb Temp 1 to determine the ambient air temp
DischTemp 1-8	Compressor discharge temperature sensors for compressors #1 through #8
Liq Level	Liquid level transducer
Comp Amps	Current transducer measuring current on the compressor pack
Cond Amps	Current transducer measuring current on the condenser
Suct Temp	Suction return air gas temperature
Dig Fault	External digital fault detection device - CLOSED when the pack is failed
Alarm Reset	Input used for switch or push-button to reset alarms active on the PAK
VSD Fault	Connected to the fault output from the VS Fan inverter - notifies the PAK of an inverter failure
Liq Level	Dry-contact liquid level sensor

Table 4-1 *- MultiFlex PAK Input Types*

4.1.2. The PAK Default Input Assignments

Analog Input #	Definition
1	Suct Xdcr
2	Disch Xdcr
3	Amb Temp 1
4	Amb Temp 2
5	Suct Temp
6	Comp Amps
7	Cond Amps
8	Liq Level
9	DischTemp 1
10	DischTemp 2
11	DischTemp 3
12	DischTemp 4
13	DischTemp 5
14	DischTemp 6
15	DischTemp 7
16	DischTemp 8

Table 4-2 *- MultiFlex PAK Default Inputs*

4.1.3. Connecting Sensors to Input Boards

Wiring a sensor to the input points on a MultiFlex board requires three steps:

1. Connect the sensor's signal wires to the two terminals of an input point.
2. Set the input type dip switch that corresponds to the point being connected.
3. If necessary, connect the sensor to one of the 5V or 12V power terminals.

4.1.3.1. Wiring

An input point on a MultiFlex board consists of two terminals, as shown in ***Figure 4-1***. One of these terminals, labeled "SIG," reads the signal from the sensor, while the other, labeled "0v" is where the sensor's ground and/or cable shield wire is connected.

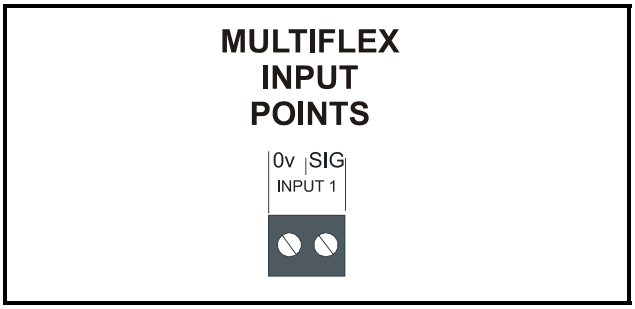


Figure 4-1 *- Input Board Points*

4.1.3.2. Sensor Wiring Types

Specific wiring types are required for each type of sensor used with E2 or RMCC.

<u>All Analog Temperature Sensors and Air Flow Sensors</u>

Temperature and air flow sensors are to be wired with shielded, 2 conductor, at least 22 GA wire (Belden # 8761 or equivalent).

<u>All Pressure Transducers, Humidity Sensors, and Refrigeration Transducers</u>

Pressure and refrigeration transducers and humidity sensors are to be wired with shielded, 3 conductor, at least 22 GA wire (Belden #8771 or equivalent).

<u>Dew Point and Light Level Sensors</u>

These sensors are to be wired with shielded, 4 conductor at least 22 GA wire (Belden # 8729 or equivalent).

4.1.3.3. Input Type Dip Switches

Each MultiFlex input point has an input type dip switch that must be set. Input type dip switches are located in the switch banks labeled S1 and S2.

The input type dip switch tells the input board whether or not the sensor connected to the point is a resistive type sensor. Generally, if the sensor or transducer supplies its own voltage signal to the point, the dip switch should be set to the LEFT (OFF) position. If the sensor uses variable resistance and requires voltage to be supplied to it from the input point, set the dip switch to the RIGHT (ON) position. Dip switches for unused points should be set to the RIGHT (ON) position.

The exception to this rule is for CPC's 5VDC pressure transducers -- though they supply their own voltage signal, the dip switch MUST be set to the RIGHT (ON) position.

4.1.4. Power Connection

If power is needed to operate the sensor, four points are provided on the MultiFlex board that supply DC power: one +12VDC point, and three +5VDC points. See ***Figure 4-2*** for the location of these points.

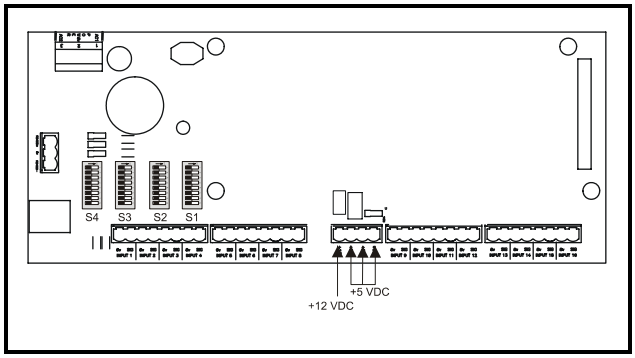


Figure 4-2 *- Input Board Power Sources*

4.1.4.1. Current Ratings for On-Board Power Sources

The maximum current that may be drawn from the +12VDC terminal is 100 milliamps. The maximum current that can be drawn from all three +5VDC terminals COMBINED is 50 milliamps.

4.1.4.2. Powering Sensors Requiring 24VAC Off the Power Transformer

Some sensors that requires 24VAC can be powered off the MultiFlex's own 24VAC power connection. To connect to the 24VAC power source, connect the sensor's power wires to terminals AC1 and AC2.

This can only be done with sensors that keep the 24VAC signal isolated from its DC output signal (such as CPC's Dew Point Probe). If the output signal is not isolated from the 24VAC input, you must use a separate transformer.

4.1.5. Sensor Types for MultiFlex Input Points

Because different controllers may be compatible with different sensor types, this manual cannot list all sensor types and how to wire them to a MultiFlex input point. Refer to your site controller's documentation for sensor wiring information.

4.2. The Relay Outputs

4.2.1. Output Types Supported by the MultiFlex PAK

Output Type	Description
Comp Grp1-8	Compressor Group output 1-8
Fan Stage 1-4	Fan Stage output 1-4
Liq Inject	Condenser Liquid Injection valve
Cond Spray	Condenser Spray valve
Alarm	Compressor discharge temperature sensors for compressors #1 through #8
VSD Fan Enable	"Run" input for an inverter operating the variable-speed fan(s)
VSD Bypass	Bypass input for an inverter operating the variable-speed fan(s)
VSD Reset	Reset input for an inverter operating the variable-speed fan(s)

Table 4-3 *- MultiFlex PAK Output Types*

4.2.2. The PAK Default Output Assignments

Relay Output #	Definition
1	Comp Grp 1
2	Comp Grp 2
3	Comp Grp 3
4	Comp Grp 4
5	Comp Grp 5
6	Comp Grp 6
7	Comp Grp 7
8	Comp Grp 8

Table 4-4 *- MultiFlex PAK Default Outputs*

4.2.3. Wiring

The MultiFlex PAK boards have Form C relay contacts. ***Figure 4-3*** shows how to wire the three-terminal Form C contact.

One wire of the two-wire connection should always be connected to the middle terminal. The second wire must either be connected to the N.C. terminal (if you want the path to be closed when the relay is de-energized) or the N.O. terminal (if you want the path to be open during power failure).

The contacts you choose also affect what the board's fail-safe dip switch will need to be set to for proper operation. Refer to ***Table 4-5*** and ***Table 4-6*** on page 13.

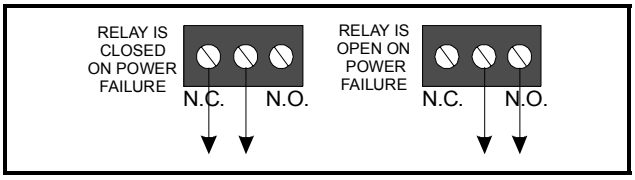


Figure 4-3 *- Form C Contact Wiring*

4.2.4. Output Fail-Safe Dip Switches

When a controller calls for a MultiFlex relay output to be ON, it sends a command to the MultiFlex to turn the output to the ON state (signified by the output LED being ON). The behavior of the relay when it is ON is determined by the position of the **fail-safe switch**. The fail-safe switches for the outputs are on a switch bank at the bottom right corner the plug-in output module. Each switch corresponds to an output on the board (switch #1 = output #1, etc.).

Table 4-5 and ***Table 4-6*** show how the fail-safe switch and Form C contacts should be configured based on how you want the output to perform during both normal operation and during network/power loss.

Note: There are not many cases where you would want a relay to be OPEN when called to be ON. For most applications, you will want to set the fail-safe switch to UP so that an ON command from the controller will close the relay.

	State of Normally Closed (N.C.) Contacts on MultiFlex Relay Points			
Fail-safe Switch	**Light is ON**	**Light is OFF**	**Loss of Communi cation**	**Loss of Power**
Up (ON)	Closed	Open	Closed	Closed
Down (OFF)	Open	Closed	Closed	Closed

Table 4-5 *- Output Board Fail-Safe and Switch Settings when Contact is Wired Normally Closed (N.C.)*

	State of Normally Open (N.O.) Contacts on MultiFlex Relay Points			
Fail-safe Switch	**Light is ON**	**Light is OFF**	**Loss of Communi cation**	**Loss of Power**
Up (ON)	Open	Closed	Open	Open
Down (OFF)	Closed	Open	Open	Open

Table 4-6 *- Output Board Fail-Safe and Switch Settings when Contact is Wired Normally Closed (N.O.)*

4.2.5. Relay Output Ratings and Fuse Protection

Each relay output on the MultiFlex Combination I/O boards is rated for up to 240 VAC with a maximum current of 2 amps.

Each relay is fused with a 2A fast-blow 5mm x 20mm fuse, Bussman GMA-2 or equivalent.

4.3. The Analog and Digital Outputs

4.3.1. Digital/Analog Output Types Supported by the MultiFlex PAK

Output Type	Description
Comp Grp1-8	Compressor Group output 1-8
Fan Stage 1-4	Fan Stage output 1-4
Liq Inject	Condenser Liquid Injection valve
Cond Spray	Condenser Spray valve
Alarm	Compressor discharge temperature sensors for compressors #1 through #8
VSD Fan Enable	"Run" input for an inverter operating the variable-speed fan(s)
VSD Bypass	Bypass input for an inverter operating the variable-speed fan(s)
VSD Reset	Reset input for an inverter operating the variable-speed fan(s)
VSD Analog	Fan speed input for an inverter operating the variable-speed fan(s)
Fan Seq	Variable-voltage output driving a fan sequencer

Table 4-7 *- MultiFlex PAK Output Types*

4.3.2. The PAK Default Analog/Digital Output Assignments

Analog/Digital Output #	Definition
1	Fan Stage 1
2	Fan Stage 2
3	Liquid Inject
4	Condenser Spray

Table 4-8 *- MultiFlex PAK Default Outputs*

The MultiFlex PAK board has four outputs that may act as either digital outputs that pulse a +8VDC signal, or as analog outputs that use a variable voltage to drive a fan sequencer or VSD. Each output is rated up to 10 milliamps. These outputs are fixed to drive solid-state relays for activation/deactiviation of condenser fan stages.

For use as digital outputs, the MultiFlex PAK may be configured in the software to define 0/8V as ON/OFF or as OFF/ON.

The PAK has no hardware-based fail-safe settings (fail-safes are set up in the board firmware). All that is required is to connect the "+" terminal to the positive wire on the device and the "-" terminal to the negative (or ground) wire of the device.

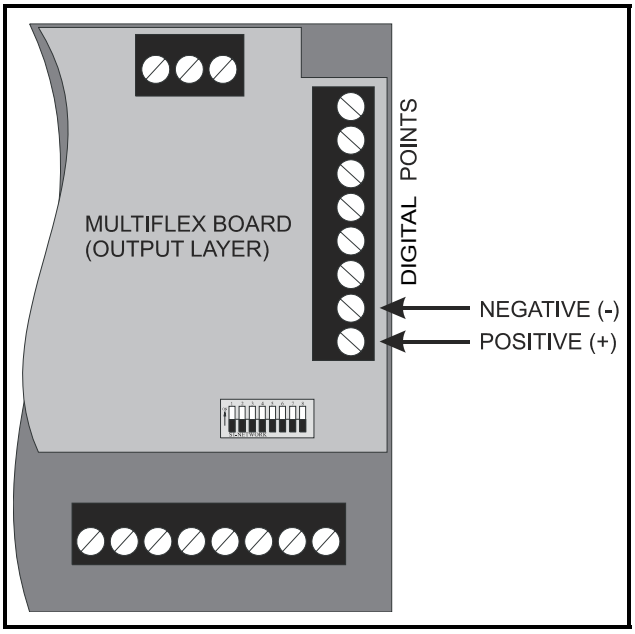


Figure 4-4 *- MultiFlex Digital Points*

5 Board Status LEDs

When a MultiFlex board is powered up, you will be able to determine the operating status of the board by observing its status LEDs. ***Figure 5-1*** shows the location of the MultiFlex's status LEDs.

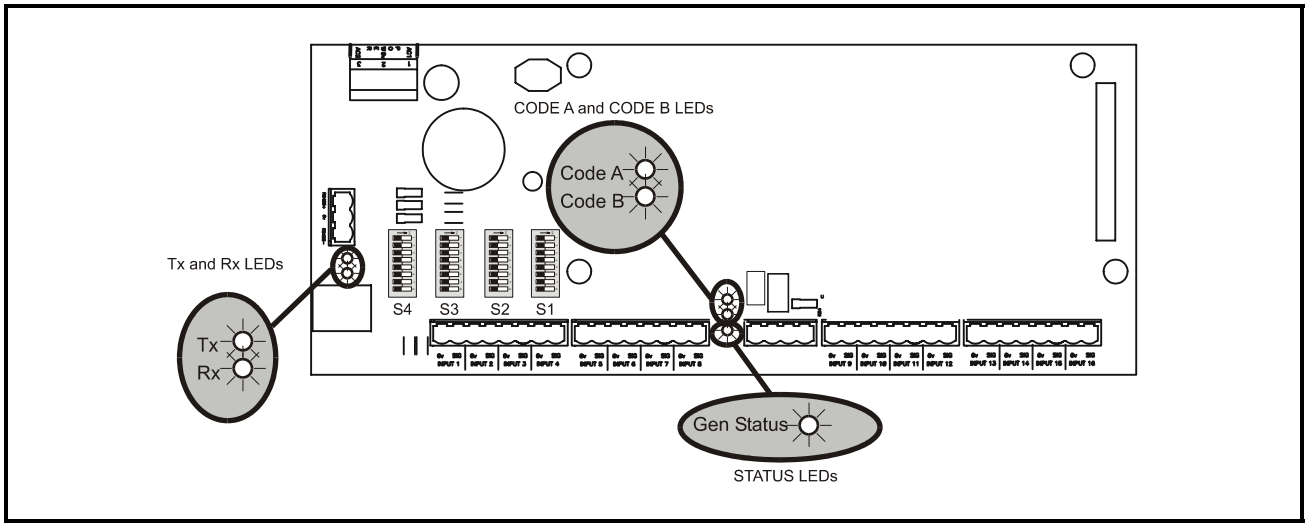


Figure 5-1 *- MultiFlex Status LED Locations*

5.1. Status LED

The Status LED simply blinks GREEN once per second to show that the board is powered and operational. If this light is dark, the board has likely lost power.

5.2. Tx and Rx LEDs

The Tx and Rx LEDs indicate when the MultiFlex is sending or receiving messages on the RS485 network.

The Tx LED blinks once every time the MultiFlex sends a response to the E2 or REFLECS. The Rx LED blinks once when the MultiFlex receives a message.

If the MultiFlex is connected to the network and set up to communicate with the controller, you should see these lights blinking regularly. If they do not, there may be a problem with the network.

5.3. Code A and Code B LEDs

The MultiFlex PAK has two LEDs labeled Code A and Code B. These LEDs indicate failure conditions. When these LEDs are OFF, there are no failures active. When one or both of these LEDs are blinking, there are failure conditions. The rate of blinking indicates the type of failure:

Code A Failure Conditions

- ***Blinking fast (4 times/second) -*** There is a problem with the flash memory or hardware clock on this board. This generally means the board is bad and must be replaced.
- ***Blinking slow (1 time/second) -*** The board is not receiving any messages addressed to it. This means either the I/O network is down or it has not yet been

commissioned in the E2 or REFLECS Network Configuration screen.

Code B Failure Conditions

- ***Blinking 2 times/second -*** This indicates the board has lost its configuration. If Code B blinks at this rate on an operational board, it means the board must be reprogrammed.

  This light does not blink if the board is new or is using the unmodified default configuration.

5.4. Relay Output LEDs

Each relay output point on a MultiFlex has an indicator LED that shows the status of the output. This LED is lit to show the output is ON, and unlit to show the output is OFF.

The definition of ON and OFF in this case is determined by the position of the fail-safe dip switch (see ***Table 4-5*** and ***Table 4-6***).

6 PAK Software Overview

6.1. Compressor Groups

6.1.1. Maximum # of Groups

The maximum number of compressor groups is eight. Each compressor group corresponds to a physical relay point on a MultiFlex board. PAK activates and deactivates compressor groups in order to control the suction pressure.

The total maximum number of individual compressors that can be controlled by the PAK is sixteen, regardless of how many compressor groups these compressors are associated with. Compressors are only activated or deactivated as part of a compressor group; however, a PAK input may be set up to read the discharge temperature for any or all of the compressor groups.

The number of compressors that may belong to a single compressor group is limited by the amperage rating on the MultiFlex output point (max. 2A up to 240VAC).

Note: When splitting up compressors into the eight groups, the total compressor HP should be spread out as much as possible to make use of as many compressor groups as possible.

6.1.2. Required Setpoints

The setpoints required for compressor group operation are: Suction Setpoint, Suction Deadband, Suction Outer Deadband, and fixed-step ON and OFF delay times. You will also need to configure which groups will be ON for each step in the fixed step strategy.

6.1.3. Compressor Group Stage Activation and Deactivation

For both Cyclic and Fixed Step compressor group control strategies, the setpoints required are:

Suction Setpoint. The suction pressure you wish to maintain.

Suction Deadband. A small range of values equally above and below the Suction Setpoint, within which the suction pressure will be considered to be acceptably near the Suction Setpoint and no stage activation or deactivation will occur.

Step ON and OFF delay times. The Step ON delay time is observed immediately after the PAK adds compressor capacity (either by cycling ON a larger number of compressors or by incrementing up one step in the Fixed Step strategy). If after bringing ON more compressors the suction pressure is still above the top part of the Suction Deadband, it must wait an amount of time equal to the Step ON delay before considering a

Suction Outer Deadband. A larger range of values equally above and below the Suction Setpoint (larger than the Suction Deadband). The Suction Outer Deadband seeks to prevent an unnecessary activation or deactivation of compressor group stages in instances where the suction pressure is just barely outside of the Suction Deadband and already moving back toward the setpoint.

When the suction pressure lies somewhere between the inner and outer deadband, it analyzes the direction and rate of change of the suction pressure over the last 1/2 of the Step ON or Step OFF delay (depending on the direction). If the calculated slope of the suction pressure during the last 1/2 of the delay indicates the suction pressure will return to within the Suction Deadband range in an amount of time equal to an additional Step ON or Step OFF delay, it will delay compressor stage changing for one delay period.

Example: a PAK has a suction setpoint of 45PSI, a Suction Deadband of 4PSI, a Suction Outer Deadband of 8PSI, and a Step ON and Step OFF delay of 30 seconds each. With all

stages turned OFF, the suction pressure climbs from 45PSI to 49PSI, taking it above the top edge of the Suction Deadband. With the Step ON delay already satisfied, the PAK will cycle ON a compressor group.

After cycling the group ON, since 49PSI is between the inner and outer deadband, the PAK will analyze the direction and slope of the suction pressure change. Fifteen seconds after the first stage activation (1/2 the Step ON delay), the suction pressure is measured to be 48.5PSI. At the end of the Step ON delay, the pressure is 48.0PSI.

Since the pressure is currently changing at a rate of -1PSI per Step ON delay period, the PAK will determine that, even though the pressure is still above the top edge of the Suction Deadband, if another Step ON delay period were to elapse with no further activations, the pressure at the end of the next delay period would be 47PSI (within the deadband). In this case, the PAK will not activate more compressors and will remain in the current state for at least one more Step ON delay period.

In the next Step ON delay period, the pressure measured at the first 15 seconds is 47.2PSI, and the pressure measured at the end of the Step ON delay period is 47.3PSI. In this case, the pressure is both above the top edge of the Suction Deadband ***and*** *increasing rather than moving toward the setpoint. In this case, the PAK will activate the next stage, bringing on more compressors.*

6.1.4. Compressor Control Strategies

6.1.4.1. Cyclic

"Cyclic" activates and deactivates compressor groups using a First-ON, First-OFF strategy.

When the PAK must add one compressor group, the group it selects will be the one that has been OFF for the longest amount of time. Likewise, when the PAK must deactivate a compressor group, it will deactivate the group that has been ON for the longest amount of time.

The advantage to the Cyclic strategy is over time the runtime of all compressor groups will be evenly distributed (also ensuring no compressors go inactive for long periods of time, thus preventing compressor failure due to lack of use). The drawback is, Cyclic strategy assumes all compressor groups are the same size in terms of HP or amp ratings. If the compressor groups are differing sizes, performance is likely to suffer when using the Cyclic strategy.

6.1.4.2. Fixed Steps

The Fixed Step strategy sequences through a series of programmed compressor group ON/OFF combinations as the PAK requires more or less horsepower to maintain set point.

When the PAK requires activation of more compressor capacity, the PAK activates the next highest numbered combination, or "step." When the PAK requires deactivation of compressors, the PAK goes to the next lowest numbered step. The Step ON and Step OFF delay is observed between each transition to prevent rapid cycling.

The maximum number of steps that may be configured is 20.

Example of Fixed steps

Table 6-1 shows an example of a fixed step strategy for a pack of 13 equally sized compressors. The compressors are split into five groups (one for each relay on the MultiFlex PAK). Then, for each of the 14 total steps in the strategy, each step is configured to bring on a different combination of groups, resulting in the total number of compressors increasing or decreasing by 1 every time a step is incremented or decre-

mented. Note that this is not necessarily a recommendation for setting up all packs using a MultiFlex PAK controller; choose a fixed step strategy that is appropriate for each installation.

Group	# Compressors	Step	Group ON	Group OFF	# of Compressors ON
1	1	1	None	1, 2, 3, 4, 5	0
2	3	2	1	2, 3, 4, 5	1
3	3	3	5	1, 2, 3, 4	2
4	4	4	1, 5	2, 3, 4,	3
5	2	5	1, 2	3, 4, 5	4
		6	2, 5	1, 3, 4	5
		7	2, 3	1, 4, 5	6
		8	3, 4	1, 2, 5	7
		9	1, 3, 4	2, 5	8
		10	3, 4, 5	1, 2	9
		11	1, 3, 4, 5	2	10
		12	1, 2, 3, 4	5	11
		13	2, 3, 4, 5	1	12
		14	1, 2, 3, 4, 5	None	13

Table 6-1 *- Example Setup of Fixed Step Strategy*

6.1.5. Suction Float

The E2, in conjunction with the PAK, may be programmed to adjust, or "float" the suction pressure setpoint based on the case temperatures of one or more cases. This feature is called **suction float**.

Suction float combines the case temperatures from up to 20 different sources into a single temperature value (either by taking the average value, the median value, or the maximum value). This value is then compared to the suction float setpoint and a deadband range around the setpoint. As a result of this comparison, the E2 may adjust the suction pressure setpoint higher or lower in an attempt to move the combined case

temperature in line with the float setpoint. A graph showing an example of suction pressure setpoint adjustment versus float temperature is provided in ***Figure 6-1***.

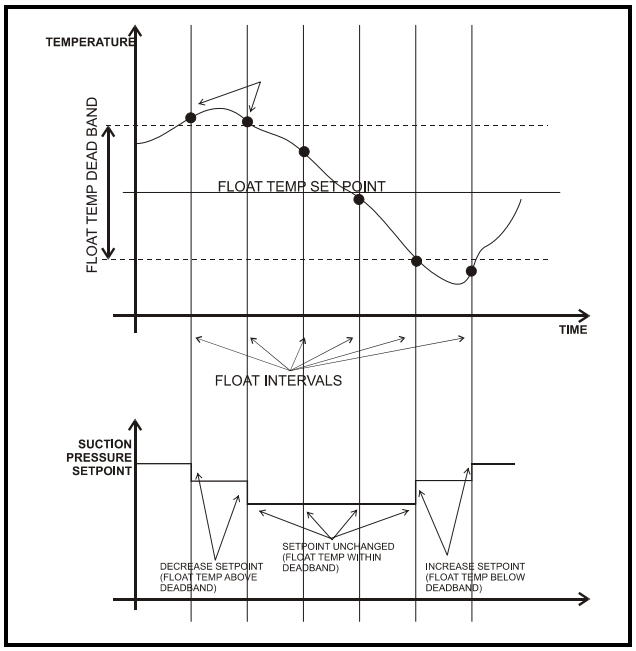


Figure 6-1 *- Suction Pressure Setpoint Vs. Float Temperature*

The amount of the interval for each adjustment, as well as the frequency of adjustment, is programmable by the user. Also, the user must specify a minimum and maximum range for the suction setpoint to prevent suction float from floating the setpoint too high or too low.

6.1.5.1. Suction Float Input Sources

Up to 20 case temperatures may be used to provide the combined case temperature used during suction float. The E2 may use case temperatures from:

- Standard Circuit applications in the E2,
- Emerson Climate Technologies EC2 case controllers,
- Danfoss EKC514 SNMP case controllers,
- WCC case controller (Microm/Tektronix/ Barker/Elm/CDK),
- Danfoss DFMC Micro-Cool case controllers.

Each case temperature input value used in the combination is determined by taking the average value of the input over a time window (called the averaging window), which averages all sampled temperatures between the current time and *x* minutes before the current time (where x is the user-defined averaging window time period). Once the averages of each input are determined, these values are then combined into a single temperature by calculating either the average value, the median value, or the maximum value. The result, called the **float temperature**, is compared to the float setpoint to determine which direction to float the suction pressure setpoint.

6.1.5.2. Defrost Inhibit

All case temperatures used as inputs for Suction Float are only used in the combined case temp calculation if they are in refrigeration mode. If a case is not in refrigeration mode, its temperature input value will be ignored.

This includes cases in defrost, pump down, drip or "drain" mode, clean or "wash" mode, and cases whose case control devices are offline or otherwise shut down.

If a case that is being inhibited returns to refrigeration mode, the E2 will wait for a user-defined delay period to elapse before including its temperature value in the combined case temp calculation. The inhibit delay is designed to allow the case enough time to recover its case temperature setpoint.

6.1.5.3. Bad Case Temp Inhibit

In addition to excluding case temperatures from circuits or case controllers that are not in refrigeration, the PAK application in the E2 will exclude up to a user-defined number of case temperatures from cases determined to be "poor performers." A poor-performing case is defined as one whose temperature deviates outside of the float temperature deadband.

When the number of cases classified as poor performers exceeds the user-defined maximum number of cases to be excluded, it will compare each case's deviation from the float temperature setpoint to determine which cases are the worst performers (highest deviations are excluded first). If desired, an alarm or notice may be generated when a poor-performing case is excluded.

6.1.5.4. Suction Float During Loss of Communication

Because suction float requires a large number of inputs and the MultiFlex PAK board has only sixteen, the PAK cannot use suction float in stand-alone mode. When the PAK is in stand-alone mode, either by design or because of loss of communication with its parent E2, suction float will be disabled and the pack will be controlled using the fixed suction pressure setpoint.

6.2. Condenser Control

The MultiFlex PAK uses a temperature differential (TD) strategy similar to the current Condenser TD strategy implemented in E2's own Condenser Control cell.

TD control in the MultiFlex PAK uses a control value that is calculated by subtracting the ambient air temperature near the condenser fans from the calculated discharge temperature (calculated by converting the discharge pressure to temperature based on the refrigerant type).

This control value is compared to a fixed temperature differential set point, and condenser fans and/or sprays are activated or deactivated to attempt to keep the control value at or near the TD set point.

6.2.1. Condenser Control Strategies

6.2.1.1. Staged Fans

In the Staged Fans strategy, when the TD value is above the setpoint, the PAK activates the FanStage outputs in sequence, beginning first with FanStage1 and ending with FanStage4. When the TD falls below the setpoint, the PAK deactivates the FanStage outputs in reverse sequence, beginning with FanStage4 and ending with FanStage1.

The PAK observes fan ON and OFF interstage delays as it activates and deactivates fan stages.

6.2.1.2. VSD Fan

The VSD Fan strategy is designed to control TD using a variable-speed fan.

The PAK uses two outputs to control the VS fan inverter: a relay or digital output called VSEnable that is CLOSED to send a "forward-run" command to the inverter, and an analog output called VSDAnalog whose voltage commands the inverter to run at a specific percentage of its maximum speed.

When the TD is above the setpoint, the PAK will close the VSEnable output and set the VSDAnalog output voltage to the user-defined minimum fan speed percentage. The VS fan will increase RPM from the minimum fan speed up to the maximum fan speed as long as the TD is above setpoint. When the TD falls below the setpoint, the fan speed is reduced until the minimum fan speed is reached, at which point the fan will be deactivated after a user-defined delay time.

6.2.1.3. Fan Sequencer

Because the MultiFlex PAK board has only twelve outputs, to conserve the number of outputs required, the PAK supports control of condenser fan stages through the use of a single

analog output, called "Fan Sequencer," which then can be used as an input to a third-party device that translates this voltage to a series of relay activations.

The control method for Fan Sequencer is similar to the method used for Staged Fans (see **Section 6.2.1.1.**), except each fan stage is represented by an analog voltage on the Fan Sequencer input. When the TD is above setpoint, the PAK starts from all fans OFF (0V) and begins activating fan stages by increasing the voltage in a series of steps (with each step corresponding to a fan stage). The user must program two setpoints: the voltage that will activate the first fan stage, and the step voltage amount that will be added to the current voltage every time a new stage is to be activated.

When the TD falls below the setpoint, the Fan Sequencer output steps down the voltage in the reverse order of its increase, until the voltage reaches 0V (all fans OFF).

Example: a sequencing device is set up to control four stages of fans, with the first sequence to be activated at an input voltage of 2.0VDC, and the remaining three to be activated with a step voltage of 1.5VDC. The Fan Sequencer voltage at each fan stage are:

Fan Seq Voltage	Active Fan Stages
0V	No fans ON
2.0V	Fan Stage 1 ON
3.5V	Fan Stages 1&2 ON
5.0V	Fan Stages 1,2,&3 ON
6.5V	All Fan Stages ON

***Table 6-2** - Example of Fan Sequencer Voltage and Fan Stage Mapping*

As the PAK brings on fan stages to lower the TD, it will start with 2V, then step up to 3.5V, 5V, and finally 6.5V to bring on fan stages. When the TD setpoint is satisfied, the PAK will sequence backwards from 6.5V to 5V, then 3.5V, 2V, and finally 0V to turn off all stages.

6.2.2. Minimum Pressure Set Point

To prevent overcooling, the MultiFlex PAK features a minimum pressure set point. If the value of the discharge/condensing pressure falls below this set point, regardless of the TD strategy, fans will be staged OFF one at a time, observing the Fan OFF Delay after each deactivation.

6.2.3. Discharge Pressure Max

The Discharge Pressure Maximum feature adds a second "line of defense" to TD control. If the value of the discharge/condensing pressure rises above the Disch Pres Max set point, fans will be cycled ON one stage at a time (observing the Fan ON delay after each activation), regardless of the number of fans called for by TD control.

6.2.4. Condenser Spray

If a condenser spray output is configured, the PAK can be programmed to activate a water spray to keep the discharge pressure from climbing above a user-defined pressure set point.

The spray is activated when the discharge pressure rises above the condenser spray set point, and shuts off when the pressure falls below the Return To Normal set point (which is the cut-off pressure for the condenser spray) longer than the Condenser Spray OFF time.

To prevent unnecessary activation of the spray when the ambient conditions make evaporative cooling less effective, the PAK can be programmed with an ambient temperate lock out, which prevents the spray from activating if the ambient temperature is below a user-defined ambient lockout set point.

6.2.5. Interlock

Interlock is an optional feature that cycles OFF all condenser fans if:

- No compressors are operating, AND

- The discharge pressure is below a user-defined Discharge Pressure Interlock Disable setpoint.

Interlock mode ends immediately if one or more compressors is brought ON or if the discharge pressure rises above the Discharge Pressure Interlock Disable setpoint.

6.2.6. Quiet Mode

When using VS condenser fans, the PAK has a Quiet Mode which may be enabled to limit fan speed to reduce noise.

Quiet Mode is activated and deactivated through the use of an input in the E2's PAK application. This input may be tied to a Time Schedule application if you wish to enable Quiet Mode during night hours.

When the Quiet Mode input is ON, the E2 limits the maximum speed of the VS fan to the Quiet Mode % setpoint. If the VS fan is called by the PAK's condenser control algorithm to be above the Quiet Mode % setpoint, the fan speed will be fixed to the Quiet Mode % speed and the control temperature setpoint will be set equal to the current control temperature.

6.2.6.1. Exiting or Cancelling Quiet Mode

Quiet Mode is cancelled if any of the three events occur:

1. The Quiet Mode input turns OFF (Quiet Mode ends).
2. The E2 loses communication with the PAK (Quiet Mode is suspended until communication is restored).
3. The discharge pressure rises above the Disch Prs Max setpoint (the PAK will allow the fan speed to increase up to 100% until the pressure falls below the Disch Prs Max setpoint, then PAK will resume Quiet Mode).

6.2.7. Safety Features

6.2.7.1. Discharge Trip

Discharge trip is a safety feature that will shut down all compressor groups if the discharge pressure rises above a critical user-defined set point.

Discharge trip occurs immediately the moment the pressure rises above the set point. All compressors shut off, and an alarm is generated and sent to E2 notifying of the trip condition. The status screen will show the status of both the compressor groups and the condenser fans as "Disch Trip."

The pack remains shut down for a minimum user-defined reset delay. When this delay has passed, the PAK will automatically reset the discharge trip and resume operation if and only if the discharge pressure has fallen to an acceptable level (determined by a user-defined reset pressure differential).

The PAK will only automatically reset a discharge trip a user-defined number of times in a one-hour period (default is five). After the discharge trip occurs this number of times, the pack will be shut down and will remain shut down for the remainder of the one-hour period. After the one-hour period, the PAK will repeat the cycle of automatic retries until auto-reset is successful or the alarm is manually reset in E2.

6.2.8. Alarms

The Multiflex PAK will communicate the following alarm conditions:

- High Discharge Pressure Trip
- If a defined physical analog input sensor reading is OPEN or SHORT
- If the Multiflex PAK controller has a digital output as an Alarm Output, then the relay will close when High Discharge Pressure Trip is active.
- If set to Yes, the Reset Alarm function will reset all alarms and restart the PAK.

7 MultiFlex PAK E2 Interface

The MultiFlex PAK is capable of communicating with an E2 RX refrigeration controller version 2.10 and above, or an Einstein RX refrigeration controller with software version 1.83 or above.

In order to take advantage of new E2 and PAK features such as Danfoss EKC514 integration, the E2 must be version 2.60 or above. The Einstein RX and E2 versions before 2.60 do not support Danfoss EKC514 or some of the advanced features of suction float.

Using MultiFlex PAK boards with a central Einstein controller offers several benefits over simple stand-alone PAK control, including:

- Reporting of PAK-related alarms in the Alarm Advisory Log
- The ability to log PAK inputs in an E2 logging group
- Remote access to PAK status and programming from the E2 front panel or remote communication tools (InSite or UltraSite32).

Communication between E2 and a PAK takes place over the RS485 I/O Network. Follow the instructions in **Section 3,** *The I/O Network*, to connect the PAKs to the E2 I/O network. Then, follow the instructions in this chapter to set up the PAKs.

7.1. Adding/Deleting a PAK

7.1.1. Adding a PAK

Before an E2 will communicate with a PAK, it must be added as an I/O board. This task is performed in the Controller Setup screen. To access this screen:

E2

1. Log in to the E2.
2. Press Menu, & 7 to access the System Configuration Menu.
3. Press & 7 - Network Status/Setup
4. Press @ 2 - Connected I/O Boards & Controllers.
5. Enter the number of PAK boards that will be networked with this E2 in the PAK Controllers field.

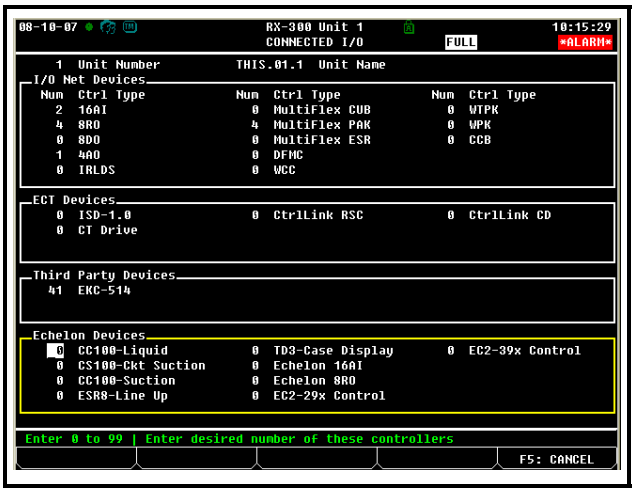


Figure 7-1 *- Controller Setup Screen*

NOTE: Unlike other MultiFlex board types, the PAK will NOT automatically show as "Online" in the Online Status screen. You must first set the "Connected" parameter in the PAK application to "Yes." See **Section 7.2.,** *Setting the "Connected" and "Read Setpoints" Attributes.*

7.1.2. Deleting a PAK

To remove a PAK from the E2:

E2
1. Log in to the E2.
2. Press Menu & 7 to access the System Configuration Menu.
3. Press & 7 - Network Status/Setup
4. Press @ 2 - Connected I/O Boards & Controllers.
5. Change the number of PAK boards in the PAK Controllers field to the correct number of boards.

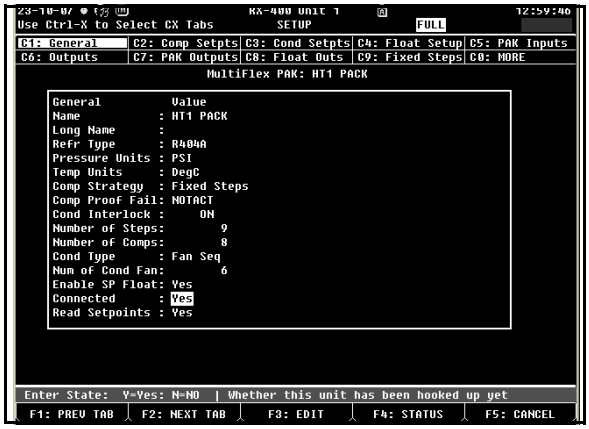
When PAKs are deleted in this way, E2 will always delete the highest numbered PAKs first. Therefore, if you have seven PAKs (numbered 1-7) and you change the number of PAKs to five, the E2 will delete board #6 and #7, leaving boards #1 through #5.

7.2. Setting the "Connected" and "Read Setpoints" Attributes

Unlike other MultiFlex devices, the PAK will not automatically communicate with the E2 once the board is properly numbered and added in the Connected I/O screen. To enable communication with the PAK, you must set the "Connected" parameter in the General tab of the PAK setup screens to "Yes." By default, a new PAK added to the E2 will have the "Connected" parameter set to "No."

The PAK also has a feature called Read Setpoints, which allows contractors who configure the PAK via Hand-Held Terminal before connection to an E2 to have the PAK setpoints saved to the E2 upon initial connection.

1. Press Menu % 5 (Configured Applications).
2. Select item "187. MultiFlex PAK". If multiple PAKs are associated with this E2, a list will appear prompting you to select a single PAK. Use the arrow keys to highlight the PAK you wish to view, and press Enter.
3. Press F5 - SETUP.
4. Use the arrow keys to highlight the "Connected" field. Press Y to set this field to Yes.
5. If you want the E2 to read the setpoints from the PAK and write them to the E2 upon connection, set the "Read Setpoints" field to Yes.



6. Press ↵ to save changes and return to the Status Screen.

The E2 will attempt to establish connection with the PAK. If the Read Setpoints field was set to Yes, the E2 will read the setpoints from the PAK and write them to the PAK application's configuration. If Read Setpoints is set to No, the E2 will write the PAK application's setpoints to the PAK upon initial connection.

7.2.1. Verifying Online Status

If you have properly set up the MultiFlex PAK board on this E2's I/O Network, after setting the Connected parameter, you can go view the status of the I/O Network (press Menu & 7 & 7 ! 1 - Online Status). If E2 and the PAK boards are communicating, this screen will show the PAK board as "Online." If not, it will be shown as "Offline."

All PAK boards whose associated E2 applications have their "Connected" parameters set to No will be shown in this screen as status "Unknown."

7.3. Viewing the PAK Status Screen

Once you have added a PAK to the E2, you will be able to see the status of the PAK board(s) from the front panel.

E2

1. Press Menu % 5 (Configured Applications).
2. Select item "187. MultiFlex PAK"

If multiple PAKs are associated with this E2, a list will appear prompting you to select a single PAK. Use the arrow keys to highlight the PAK you wish to view, and press Enter.

The PAK Status Screen for the PAK you selected will appear (***Figure 7-2***).

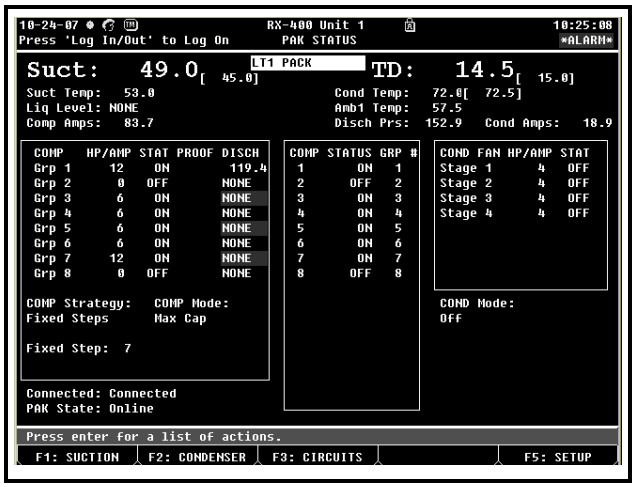


Figure 7-2 *- PAK Status Screen*

The PAK Status Screen shows the current status of all compressors and condensers. Though there is a large amount of information on a PAK status screen, status information is grouped on this screen in several groups of related information in order to make the screen easier to read. These groups are described below.

7.3.1. Inputs and Set Points

The top four lines of the PAK Status Screen show the current values of all the important inputs and set points in the PAK controller.

Suct

The Suct field shows the current value of the suction pressure. The value shown in smaller type to the right of the suction pressure field (enclosed by brackets [ ]) is the suction pressure control set point, displayed here for reference purposes.

TD

The TD field shows the current calculated value of the temperature differential between the discharge temperature and the ambient temperature. The value shown in smaller type to the right of the TD field (enclosed by brackets [ ]) is the TD set point, displayed here for reference purposes.

Suction Temp

This field shows the value of the PAK's suction return gas temperature input.

Liquid Level

This field shows the value of the PAK's liquid level input.

Comp Amps

This field shows the value of the PAK's Compressor Amps input.

Cond Temp

This field shows the condenser discharge temperature calculated by converting the discharge pressure to temperature based on the system refrigerant.

Amb Temp 1

The Amb Temp 1 field shows the current value of the ambient temperature sensor on the condenser.

Disch

This field shows the current value of the discharge pressure transducer.

Cond Amps

This field shows the current value of the PAK's Condenser Amps input.

7.3.2. Compressor Groups

The box left of the middle of the PAK Status Screen shows the current status of the compressor groups defined for the PAK.

Compressor Group HP/AMPS and Status

Each group from 1 through 8 has a field showing HP/AMPS, which displays the total amount of HP or AMPS of all compressors associated with the group, and a Status field, which shows whether the group is currently ON or OFF.

COMP Mode

The Compressor Group Mode field explains the current state of the fixed step control algorithm in the MultiFlex PAK. There are seven messages that may appear here:

- OFF - No compressor groups are ON, and none are being called to be ON.
- Off Delay - The MultiFlex PAK requires less compressor HP/AMPS, and is trying to cycle backward through the fixed steps, but PAK is currently waiting for the fixed step OFF delay to elapse before moving to the next lower step.
- On Delay - The MultiFlex PAK requires more compressor HP/AMPS, and is trying to cycle forward through the fixed steps, but PAK is currently waiting for the fixed step ON delay to elapse before moving to the next higher step.
- DeadBand - The suction pressure is within the set point dead band. The PAK will remain on the current fixed step and is not attempting to move up or down to a new step.
- Max Cap - The PAK has cycled through the fixed steps all the way to the last step, but the set point is still out of range. In other words, the PAK would activate more HP/AMPS if more were available, but it is operating at maximum capacity.
- XDucer Fail - The suction pressure transducer input has failed.
- Disch Trip - The discharge pressure has exceeded the discharge trip setpoint, causing the compressor group to shut down.

Fixed Step

This field shows the number of the currently active fixed step.

7.3.3. Compressor Status

Because compressor group stages may contain more than one compressor, the center box shows the status of each individual compressor in the PAK, along with the compressor group number assignment.

7.3.4. Condenser Fans

The right side of the PAK Status Screen shows the current status of the condenser fans.

Fan Stages 1 through 4

If the condenser is using single-speed fan stages (either by using "Staged Fans" strategy to control the fan stage relays OR by using "Fan Sequencer" to control the fan stages through an analog sequencer), the status of each fan stage from 1 through 4 will be shown in a box on the right side of the screen.

VS Fan Status

If the condenser is using variable-speed fans, the VS % and the state of the VSD Enable relay will be shown on the right side of the screen. A VS Fault status will also be shown, which will display "ON" if the inverter has failed.

Cond Mode

The Condenser Mode field explains the current state of the condenser fan control algorithm in the MultiFlex PAK. There are seven messages that may appear here:

- OFF - All condenser fans are OFF, and the discharge pressure/temperature is low enough to not require any fans to be activated.
- OFF Delay - The PAK is calling for fan stages to deactivate, and PAK is waiting for the OFF Delay time period to elapse before deactivating the next fan stage.

- ON Delay - The PAK is calling for fan stages to activate, and PAK is waiting for the ON Delay time period to elapse before activating the next fan stage.
- DeadBand - The discharge pressure is within the setpoint deadband, and therefore the PAK is neither activating nor deactivating any fan stages.
- Max Cap - All condenser fans are ON, but the discharge pressure is still above set point. In other words, PAK would activate more fan stages if more were available, but it is operating at maximum capacity.
- Cond Spray - The condenser spray output is currently ON, meaning the discharge pressure is currently higher than the condenser spray set point.

7.3.5. Connected and PAK State

At the very bottom of the PAK Status Screen, the "Connected" field shows the state of the PAK application's "Connected" parameter, thus showing whether the PAK has been enabled for communication. "Connected" means the Connected parameter is set to Yes; "Not Connected" means the parameter is set to No.

The "PAK State" field shows whether the MultiFlex PAK is currently reading as Online or Offline.

Note that a status of "Connected" in the Connected field does not necessarily mean the PAK is communicating with the E2 - if the PAK State reads "Offline,"

7.4. Programming the PAK using E2

To begin programming a PAK, navigate to the PAK Status Screen for the board you wish to program (see **Section 7.3.**). For E2, press F5 to enter the Setup Editor.

Each setup screen contains a number of fields used to program the PAK or the E2 interface to the PAK. For descriptions of each field, highlight the field value using the arrow keys, then press ? (HELP) to read the on-line help.

7.4.1. Screen 1: General

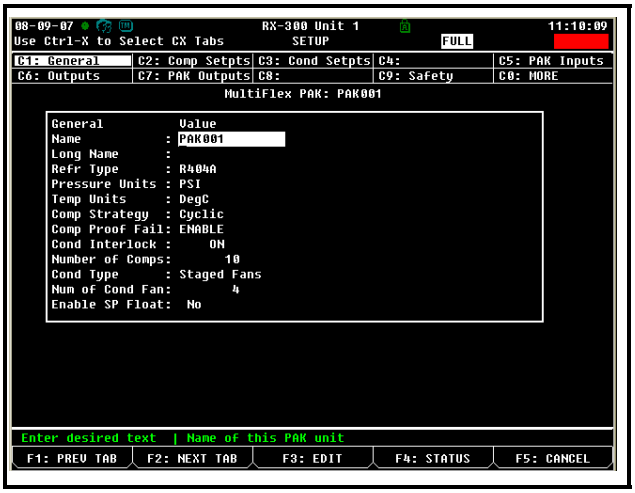

08-09-07 RX-300 Unit 1 11:10:09
Use Ctrl-X to Select CX Tabs SETUP FULL
C1: General C2: Comp Setpts C3: Cond Setpts C4: C5: PAK Inputs
C6: Outputs C7: PAK Outputs C8: C9: Safety C0: MORE
MultiFlex PAK: PAK001
General Value
Name : PAK001
Long Name :
Refr Type : R404A
Pressure Units : PSI
Temp Units : DegC
Comp Strategy : Cyclic
Comp Proof Fail: ENABLE
Cond Interlock : ON
Number of Comps: 10
Cond Type : Staged Fans
Num of Cond Fan: 4
Enable SP Float: No
Enter desired text | Name of this PAK unit
F1: PREV TAB F2: NEXT TAB F3: EDIT F4: STATUS F5: CANCEL

Figure 7-3 *- PAK Screen 1: General*

In the General screen, enter a name for the PAK application, specify the temperature and pressure units you will be using, and enter the number of compressors and condenser fans.

7.4.2. Screen 2: Comp Setpts

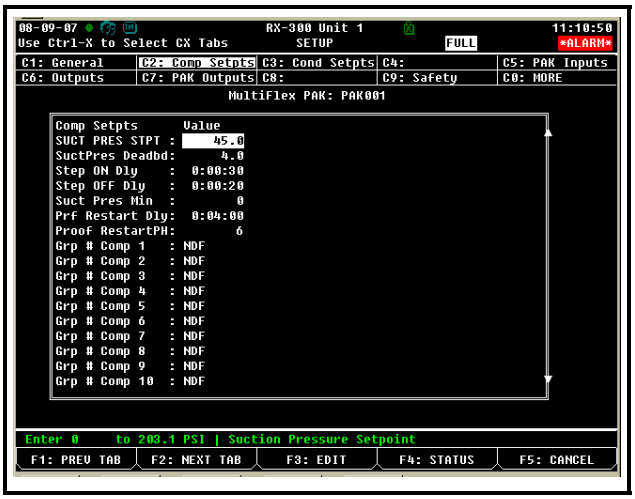

08-09-07 RX-300 Unit 1 11:10:50
Use Ctrl-X to Select CX Tabs SETUP FULL *ALARM*
C1: General C2: Comp Setpts C3: Cond Setpts C4: C5: PAK Inputs
C6: Outputs C7: PAK Outputs C8: C9: Safety C0: MORE
MultiFlex PAK: PAK001
Comp Setpts Value
SUCT PRES STPT : 45.0
SuctPres Deadbd: 4.0
Step ON Dly : 0:00:30
Step OFF Dly : 0:00:20
Suct Pres Min : 0
Prf Restart Dly: 0:04:00
Proof RestartPH: 6
Grp # Comp 1 : NDF
Grp # Comp 2 : NDF
Grp # Comp 3 : NDF
Grp # Comp 4 : NDF
Grp # Comp 5 : NDF
Grp # Comp 6 : NDF
Grp # Comp 7 : NDF
Grp # Comp 8 : NDF
Grp # Comp 9 : NDF
Grp # Comp 10 : NDF
Enter 0 to 203.1 PSI | Suction Pressure Setpoint
F1: PREV TAB F2: NEXT TAB F3: EDIT F4: STATUS F5: CANCEL

Figure 7-4 *- PAK Screen 2: Compressor Setpoints*

The Compressor Setpoints screen is where you must enter the suction pressure setpoint and deadband, as well as assign each compressor to a compressor group.

7.4.3. Screen 3: Cond Setpts

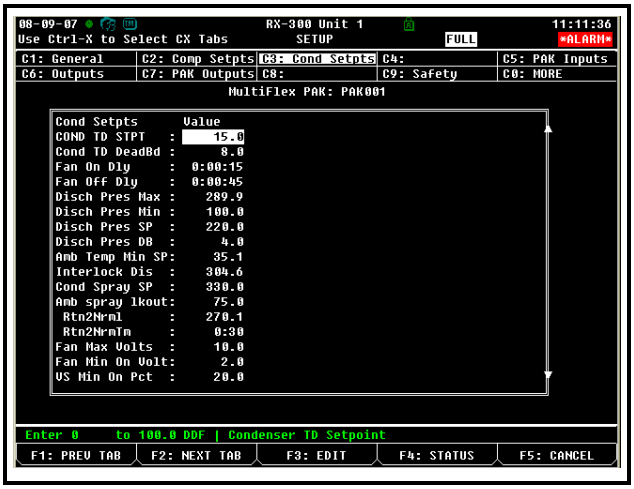

08-09-07 RX-300 Unit 1 11:11:36
Use Ctrl-X to Select CX Tabs SETUP FULL *ALARM*
C1: General C2: Comp Setpts C3: Cond Setpts C4: C5: PAK Inputs
C6: Outputs C7: PAK Outputs C8: C9: Safety C0: MORE
MultiFlex PAK: PAK001
Cond Setpts Value
COND TD STPT : 15.0
Cond TD DeadBd : 8.0
Fan On Dly : 0:00:15
Fan Off Dly : 0:00:45
Disch Pres Max : 289.9
Disch Pres Min : 100.0
Disch Pres SP : 220.0
Disch Pres DB : 4.0
Amb Temp Min SP: 35.1
Interlock Dis : 304.6
Cond Spray SP : 330.0
Amb spray 1kout: 75.0
Rtn2Nrml : 270.1
Rtn2NrmTm : 0:30
Fan Max Volts : 10.0
Fan Min On Volt: 2.0
VS Min On Pct : 20.0
Enter 0 to 100.0 DDF | Condenser TD Setpoint
F1: PREV TAB F2: NEXT TAB F3: EDIT F4: STATUS F5: CANCEL

Figure 7-5 *- PAK Screen 3: Condenser Setpoints*

The Condenser Setpoints screen is where you must enter the discharge pressure setpoint and deadband, as well as setpoints that determine the TD calculation and operation of other condenser systems such as the condenser spray.

Condenser fans are also assigned to condenser fan groups (outputs) in this screen.

7.4.4. Screen 4: Float Setup

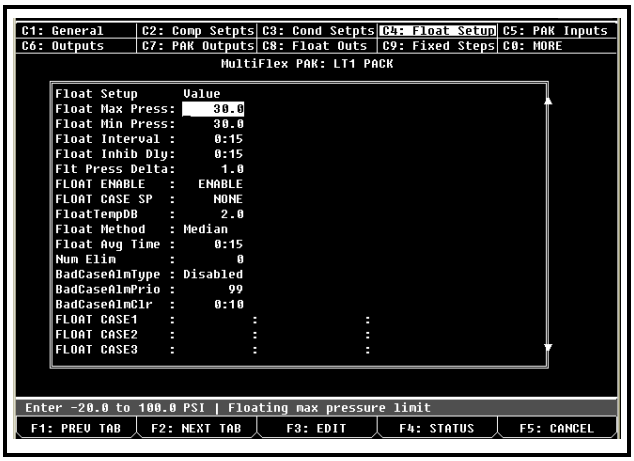

C1: General C2: Comp Setpts C3: Cond Setpts C4: Float Setup C5: PAK Inputs
C6: Outputs C7: PAK Outputs C8: Float Outs C9: Fixed Steps C0: MORE
MultiFlex PAK: LT1 PACK
Float Setup Value
Float Max Press: 30.0
Float Min Press: 30.0
Float Interval : 0:15
Float Inhib Dly: 0:15
Fit Press Delta: 1.0
FLOAT ENABLE : ENABLE
FLOAT CASE SP : NONE
FloatTempDB : 2.0
Float Method : Median
Float Avg Time : 0:15
Num Elim : 0
BadCaseAlmType : Disabled
BadCaseAlmPrio : 99
BadCaseAlmClr : 0:10
FLOAT CASE1 : : :
FLOAT CASE2 : : :
FLOAT CASE3 : : :
Enter -20.0 to 100.0 PSI | Floating max pressure limit
F1: PREV TAB F2: NEXT TAB F3: EDIT F4: STATUS F5: CANCEL

Figure 7-6 *- PAK Screen 4: Float Setup Setpoints*

The Float Setup screen is where setpoints and case temperature inputs for the Suction Float feature are configured. This screen is not visible unless the Enable SP Float parameter on Screen 1 is set to "Yes."

The Float Case input definitions are where you must define each circuit's case temp value. As long as the source of the case temp value is a Danfoss EKC514, DFMC, Woodley case controller, EC2 case controller, or E2 Standard Circuit application, the E2 will automatically read the controller or application's case state (refrigeration, defrost, etc.) and consider the case state when determining whether or not to exclude the case's temperature from the suction float temperature combination.

7.4.5. Screen 5: PAK Inputs

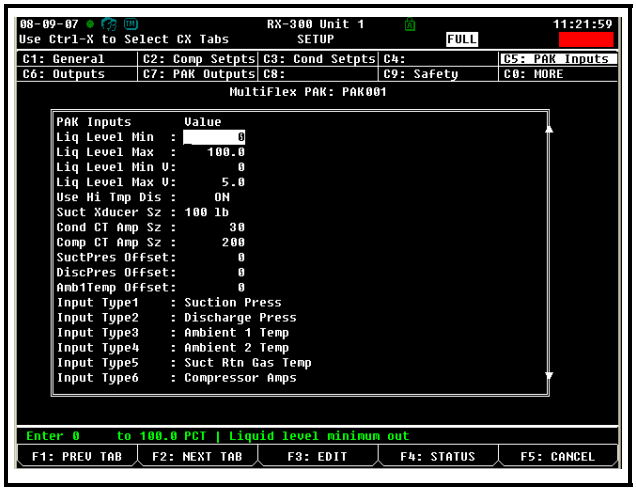

08-09-07 RX-300 Unit 1 11:21:59
Use Ctrl-X to Select CX Tabs SETUP FULL
C1: General C2: Comp Setpts C3: Cond Setpts C4: C5: PAK Inputs
C6: Outputs C7: PAK Outputs C8: C9: Safety C0: MORE
MultiFlex PAK: PAK001
PAK Inputs Value
Liq Level Min : 0
Liq Level Max : 100.0
Liq Level Min V: 0
Liq Level Max V: 5.0
Use Hi Tmp Dis : ON
Suct Xducer Sz : 100 lb
Cond CT Amp Sz : 30
Comp CT Amp Sz : 200
SuctPres Offset: 0
DiscPres Offset: 0
Amb1Temp Offset: 0
Input Type1 : Suction Press
Input Type2 : Discharge Press
Input Type3 : Ambient 1 Temp
Input Type4 : Ambient 2 Temp
Input Type5 : Suct Rtn Gas Temp
Input Type6 : Compressor Amps
Enter 0 to 100.0 PCT | Liquid level minimum out
F1: PREV TAB F2: NEXT TAB F3: EDIT F4: STATUS F5: CANCEL

Figure 7-7 *- PAK Screen 5: PAK Inputs*

The PAK Inputs screen is where you must assign each of the 16 PAK inputs to an input type. Other setpoints on this screen control how certain inputs are read (such as liquid level sensors, CTs, and the suction transducer).

7.4.6. Screen 6: Outputs

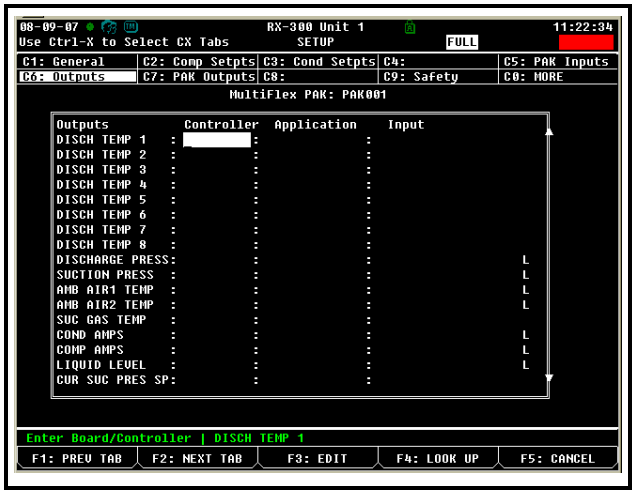

08-09-07 RX-300 Unit 1 11:22:34
Use Ctrl-X to Select CX Tabs SETUP FULL
C1: General C2: Comp Setpts C3: Cond Setpts C4: C5: PAK Inputs
C6: Outputs C7: PAK Outputs C8: C9: Safety C0: MORE
MultiFlex PAK: PAK001
Outputs Controller Application Input
DISCH TEMP 1
DISCH TEMP 2
DISCH TEMP 3
DISCH TEMP 4
DISCH TEMP 5
DISCH TEMP 6
DISCH TEMP 7
DISCH TEMP 8
DISCHARGE PRESS
SUCTION PRESS
AMB AIR1 TEMP
AMB AIR2 TEMP
SUC GAS TEMP
COND AMPS
COMP AMPS
LIQUID LEVEL
CUR SUC PRES SP
Enter Board/Controller | DISCH TEMP 1
F1: PREV TAB F2: NEXT TAB F3: EDIT F4: LOOK UP F5: CANCEL

Figure 7-8 *- Screen 6: Outputs*

The Outputs screen of the E2 PAK application provides output definitions that may be used to connect PAK outputs to inputs of other applications for use in extended I/O control. No user programming is required in this screen when programming the PAK.

7.4.7. Screen 7: PAK Outputs

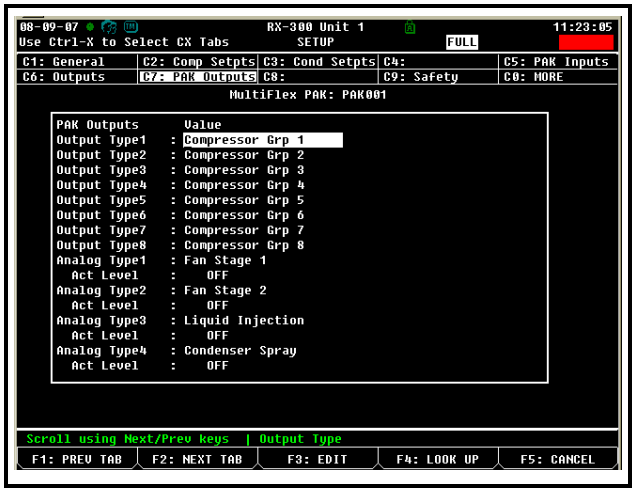

08-09-07 RX-300 Unit 1 11:23:05
Use Ctrl-X to Select CX Tabs SETUP FULL
C1: General C2: Comp Setpts C3: Cond Setpts C4: C5: PAK Inputs
C6: Outputs C7: PAK Outputs C8: C9: Safety C0: MORE
MultiFlex PAK: PAK001
PAK Outputs Value
Output Type1 : Compressor Grp 1
Output Type2 : Compressor Grp 2
Output Type3 : Compressor Grp 3
Output Type4 : Compressor Grp 4
Output Type5 : Compressor Grp 5
Output Type6 : Compressor Grp 6
Output Type7 : Compressor Grp 7
Output Type8 : Compressor Grp 8
Analog Type1 : Fan Stage 1
Act Level : OFF
Analog Type2 : Fan Stage 2
Act Level : OFF
Analog Type3 : Liquid Injection
Act Level : OFF
Analog Type4 : Condenser Spray
Act Level : OFF
Scroll using Next/Prev keys | Output Type
F1: PREV TAB F2: NEXT TAB F3: EDIT F4: LOOK UP F5: CANCEL

Figure 7-9 *- PAK Screen 7: PAK Outputs*

The PAK Outputs screen is where you must assign the functions of each of the eight relay outputs and four analog/digital outputs on the MultiFlex PAK.

7.4.8. Screen 8: Fixed Steps

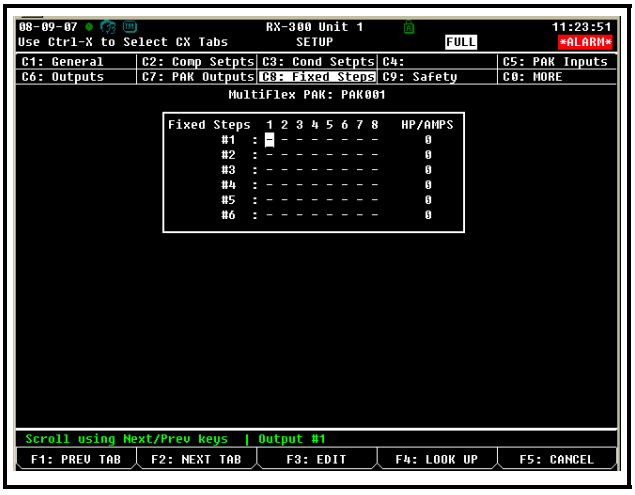

08-09-07 RX-300 Unit 1 11:23:51
Use Ctrl-X to Select CX Tabs SETUP FULL *ALARM*
C1: General C2: Comp Setpts C3: Cond Setpts C4: C5: PAK Inputs
C6: Outputs C7: PAK Outputs C8: Fixed Steps C9: Safety C0: MORE
MultiFlex PAK: PAK001
Fixed Steps 1 2 3 4 5 6 7 8 HP/AMPS
#1 0
#2 0
#3 0
#4 0
#5 0
#6 0
Scroll using Next/Prev keys | Output #1
F1: PREV TAB F2: NEXT TAB F3: EDIT F4: LOOK UP F5: CANCEL

Figure 7-10 *- PAK Screen 8: Fixed Steps*

The number of steps that appear on this screen is determined by the number entered in the "Number of Steps" field in Screen 1.

For each step, specify which compressor groups will be active by changing the field in the numbered column representing the group number to "X." Inactive compressor groups must have a "-" in the group number field. Use the Prev and > keys to toggle the field value.

Refer to **Section ,** *Example of Fixed steps*, for more information about setting up fixed steps.

7.4.9. Screen 9: Safety

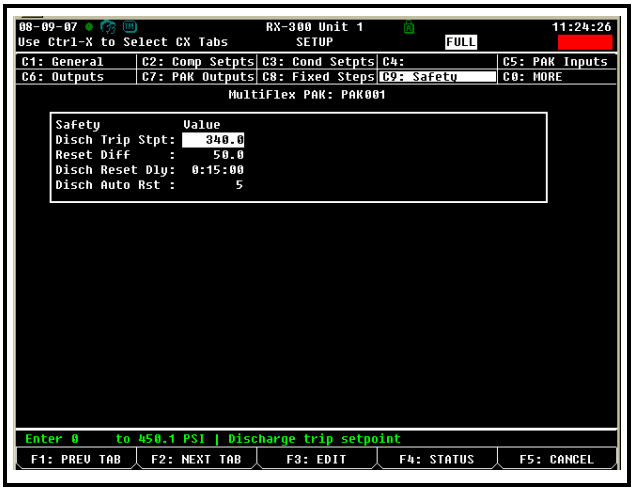


Figure 7-11 *- PAK Screen 9: Safety*

The Safety screen is used to set up various safety shutdown features for the PAK such as discharge trip and suction temperature trip.

7.4.10.Screen B: Alarms

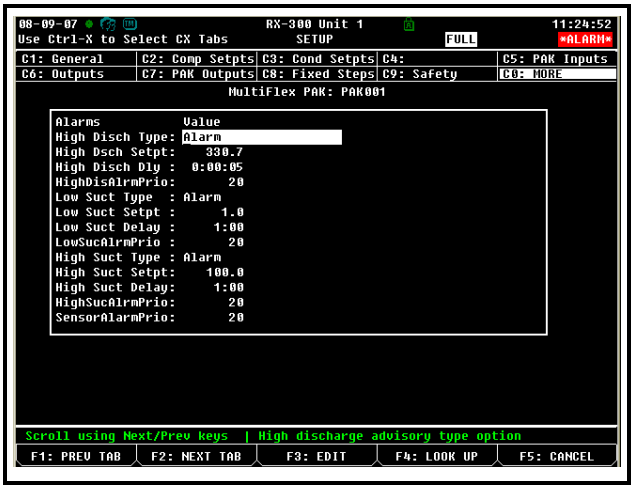


Figure 7-12 *- PAK Screen B: Alarms*

This screen is under the "MORE" tab at the top of the screen, and is accessible by pressing Ctrl + 0 and then selecting B -Alarms.

This screen is where you specify what type of advisories you want the E2's PAK application to generate when failures occur. You may choose advisory types, setpoints, priorities, and delays for most alarm types generated by the PAK.

8 MultiFlex PAK Hand-Held Terminal Interface

All MultiFlex boards have a Hand-Held Terminal interface, which can be used to view status for the board without having to use the site controller. Though different for each model of MultiFlex, the Hand-Held Terminal interface allows you to perform the same general functions:

- View failure messages that relate to the MultiFlex
- View the status of inputs
- View the current state of relay outputs (ON or OFF) and analog outputs (both in volts and in percentage)
- Override relay outputs to a fixed ON or OFF state, or override analog outputs to a fixed percentage
- Make temporary or permanent changes to set points

Plugging In the Hand-Held Terminal

The Hand-Held Terminal plugs into the RJ11 jack on the MultiFlex base board (located on the bottom left side of the board, as shown in ***Figure 8-1***). Press the Hand-Held Terminal connector into the jack until it snaps into place. When the connector is correctly seated, the screen to the Hand-Held Terminal will display the message "CPC Handheld Terminal" and then the first screen of the MultiFlex interface.

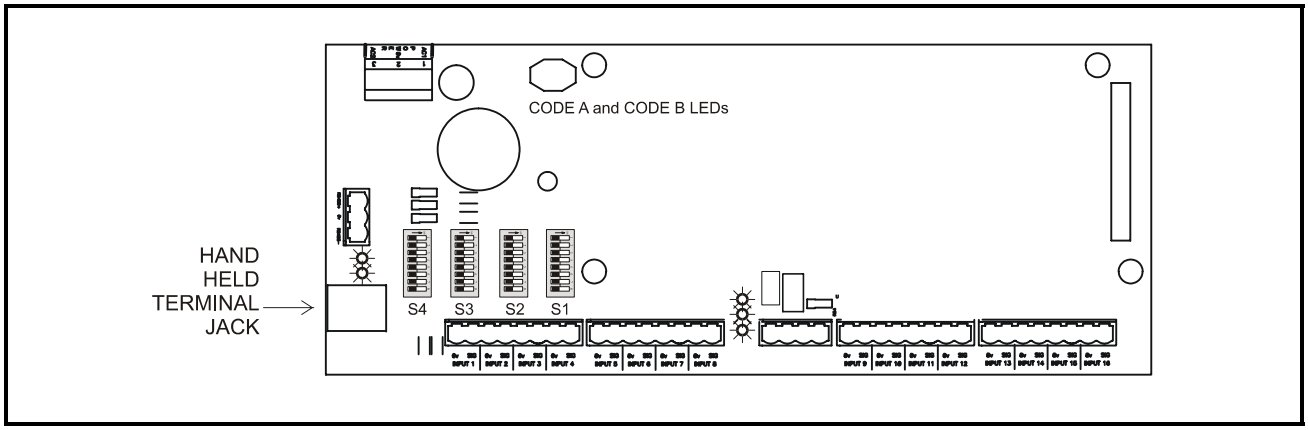


Figure 8-1 *- MultiFlex HHT Jack Location*

8.1. The HHT Interface

8.1.1. Navigation

The Hand-Held Terminal interface consists of a simple series of screens and menus.

Scrolling Through The Hand-Held Screens

The UP ARROW and DOWN ARROW keys are used to scroll through the screens. Some of these screens are read-only, meaning there are no editable fields; others are either menus that require you to enter a selection or are configuration screens that have one or more changeable fields.

Shortcut Keys (F1 and F2)

At any time, you may press the F1 key on the Hand-Held Terminal to return to the Configuration Menu, or F2 to view the status screens.

8.2. PAK Start Screens

```
MULTIFLEX PAK
    810-3082
  VER: 2.50F01
   ( PRESS ↓ )
```

When the HHT is plugged into the MultiFlex board, the HHT display will show the model type of the MultiFlex (PAK), the CPC part number, and the firmware revision.

```
DIP Settings:
Address: 1
Baud   : 9600
```

Pressing the DOWN ARROW key from the start screen displays the address and baud rate settings as read from the MultiFlex's addressing and baud rate DIP switches.

From the DIP Settings screen, pressing the DOWN ARROW key again will select the first PAK status screen. You will not be able to view the start screen or the DIP Settings screen again without disconnecting and reconnecting the HHT.

8.3. PAK Status Screens

The eleven PAK Status Screens show the current readings of all PAK inputs, the states of all outputs and proofs, and other operating information.

By default, the HHT automatically scrolls through the screens in sequence every 3 seconds. To freeze the display on the current screen, press the POINT "." button on the HHT. In this mode, you can use the UP ARROW and DOWN ARROW keys to scroll through the status screens.

8.3.1. Status Screen 1

```
Pressure(hold=.)
Suction     34.0
Discharge   99.4
Amb 1 Temp  17.7
```

Suction. The current value of the suction pressure input.

Discharge. The current value of the discharge pressure input.

Amb 1 Temp. The current value of ambient temperature sensor #1.

8.3.2. Status Screen 2

```
Comp Disch Temps
 #1 (1 to 8)  #4
 21   50   45   45
 OPE  OPE  OPE  OPE
```

This screen shows the current values of compressor discharge temperature inputs #1 through #8. The third line of the display shows inputs #1 through #4 from left to right, and the fourth line of the display shows inputs #5 through #8 from left to right.

If a sensor input is unused, disconnected, or there is a break in the wire, "OPE" will be shown to indicate an open input. If a sensor input is shorted, its value will be shown as "SHO."

8.3.3. Status Screen 3

```
    Cond TD 11.0
Amb 2 Temp OPEN
 Cond Temp  74.1
Disch Pres  99.4
```

Cond TD. The Cond TD is calculated by subtracting the ambient temperature from the condenser's discharge temperature (calculated by converting the discharge pressure to temperature). The Cond TD is compared to the PAK's Condenser TD setpoint when controlling the fans.

Amb 2 Temp. The current value of the Ambient Temp sensor #2 (or OPEN if this sensor input is unused).

Cond Temp. The Cond Temp is the condenser discharge temperature, calculated by converting the discharge pressure input value to a temperature.

Disch Press. The current value of the discharge pressure input. This is the same value as shown in Status Screen 1, only repeated here for easier comparison to the other values on this screen.

8.3.4. Status Screen 4

```
Suct Pres  34.0
DB/SP 4.0 /45.0
Comp     12345678
Groups   |00|0000
```

Suct Pres. The current value of the suction pressure input. This is the same value as shown in Status Screen 1, only repeated here for easier comparison to other values on this screen.

DB / SP. The number to the left of the slash is the programmed deadband value around the suction setpoint. The number to the right of the slash is the programmed suction setpoint.

Comp Groups. The fourth line of the display shows the current state of each of the compressor group on the PAK. The characters shown here, numbered 1 through 8, will be "|" when the compressor group is active, and "0" when the compressor group is inactive. Unused groups will also be shown as "0."

8.3.5. Status Screen 5

```
  Cond TD  12.1
DB/SP 4.4 /8.3
Cond    12345678
Fans    ||000000
```

Cond TD. The Cond TD is calculated by subtracting the ambient temperature from the condenser's discharge temperature (calculated by converting the discharge pressure to temperature). This is the same value as shown in Status Screen 3, only repeated here for easier comparison to the other values on this screen.

DB / SP. The number to the left of the slash is the programmed deadband value around the condenser TD setpoint. The number to the right of the slash is the programmed condenser TD setpoint.

Cond Fans. The fourth line of the display shows the current state of each of the condenser fan groups (corresponding to the fan group outputs on the PAK). The characters shown here, numbered 1 through 8, will be "|" when the fan group output is active, and "0" when the fan group output is inactive. Unused outputs will also be shown as "0."

8.3.6. Status Screen 6

```
Cond Temp  74.1
DB/SP 4.4 /8.3
VSD 0.0 % En OFF
0.0V   Fault OFF
```

Cond Temp. The Cond Temp is the condenser discharge temperature, calculated by converting the discharge pressure input value to a temperature.

DB / SP. The number to the left of the slash is the programmed deadband value around the current condensing temperature setpoint. The number to the right of the slash is the condensing temp setpoint, which is calculated by adding the programmed condenser TD setpoint to the ambient temp used for control.

VSD. The current operating speed of the VSD, represented as a percentage of its maximum speed.

En. The current state of the VSD Enable relay, which is ON when the VS Fan is called to be ON and OFF when the VS Fan is called to be OFF.

V. The voltage value shown directly below the VSD field is the current output voltage of the PAK analog output controlling the VS Fan.

Fault. The current state of the VSD Fault input.

8.3.7. Status Screen 7

```
Suct Temp OPEN
Comp Amps NDF
Cond Amps NDF
Liq Level 37.0
```

Suct Temp. The current value of the suction temperature input value, or OPEN if unused.

Comp Amps. The value of the current transducer measuring amperage used by the compressor pack. If unused, the value will be "NDF."

Cond Amps. The value of the current transducer measuring amperage used by the condenser fans. If unused, the value will be "NDF."

Liq Level. The current value of the liquid level probe, or "NDF" if unused. If the liquid level sensor is digital, the value will read OK or NotOK.

8.3.8. Status Screen 8

```
QuietMode En OFF
  Cond Spray OFF
Liqid Inject ON
       Alarm OFF
```

QuietMode EN. If Quiet Mode is currently enabled, the status will read ON. If Quiet Mode is disabled or not being used, the status will read OFF.

Cond Spray. The state of the Condenser Spray output.

Liquid Inject. The state of the Liquid Inject output.

Alarm. If an output is set up as type "Alarm," this shows the state of that output, which is ON whenever an alarm is active on the PAK, and OFF when no alarms are active. If no output is set up, the value shown here will still be ON or OFF depending on whether or not alarms are active.

8.3.9. Status Screen 9

```
12345678<Fans
||||0000
1234567<Comps>16
||000|00|0000000
```

This screen shows the current state of individual condenser fans (#1 through #8) and compressors (#1 through #16), NOT THE GROUPS. When a fan or compressor group is active, the fans or compressors that are associated with that group will be shown here as "|". When inactive or not used, the fans or compressors will be shown as "0".

8.3.10. Status Screen 10

```
Comp Proof Stats
12345678<Groups
00000000<Fail(|)
00000000<Alarm
```

This screen shows the proof failure status and alarm status of each of the eight compressor groups. Line three of the display shows failures; line four shows alarms. If a proof failure or alarm is active for a compressor group, the display will show "|" in the column under the compressor's group number. Otherwise, the display will show "0".

8.3.11. Status Screen 11

```
[Modes]
Comp: OFF
Cond: ON Delay
Suct Float: OFF
```

Comp. The Compressor Group Mode field explains the current state of the control algorithm in the MultiFlex PAK. There are seven messages that may appear here:

- OFF - No compressor groups are ON, and none are being called to be ON.
- Off Delay - The MultiFlex PAK requires less compressor HP/AMPS, but PAK is currently waiting for the Step OFF delay to elapse before decreasing capacity.

- On Delay - The MultiFlex PAK requires more compressor HP/AMPS, but PAK is currently waiting for the Step ON delay to elapse before increasing capacity.
- DeadBand - The suction pressure is within the Suction Deadband. The PAK will continue operating at the current capacity.
- Max Cap - Based on the current value of the suction pressure, the PAK would activate more HP/AMPS if more were available, but it is operating at maximum capacity.
- XDucer Fail - The suction pressure transducer input has failed.
- Disch Trip - The discharge pressure has exceeded the discharge trip setpoint, causing the compressor group to shut down.
- OutDB Delay - Due to the Suction Outer Deadband feature, the PAK has skipped a compressor stage change because it determined the suction pressure was returning to within the Suction Deadband.

Cond. The Condenser Mode field explains the current state of the condenser fan control algorithm in the MultiFlex PAK. There are seven messages that may appear here:

- OFF - All condenser fans are OFF, and the discharge pressure/temperature is low enough to not require any fans to be activated.
- OFF Delay - The PAK is calling for fan stages to deactivate, and PAK is waiting for the OFF Delay time period to elapse before deactivating the next fan stage.
- ON Delay - The PAK is calling for fan stages to activate, and PAK is waiting for the ON Delay time period to elapse before activating the next fan stage.
- DeadBand - The TD is within the setpoint deadband, and therefore the PAK is neither activating nor deactivating any fan stages.
- Max Cap - All condenser fans are ON, but the TD is still above set point. In other words, PAK would activate more fan stages if more were available, but it is operating at maximum capacity.
- Quiet Max - Same as Max Cap (see above), except Quiet Mode is currently active and the PAK is operating the VS fan at the maximum speed allowed by the Quiet Mode % setpoint.
- Cond Spray - The condenser spray output is currently ON.

Suct Float. If the PAK is currently enabling suction float to occur, the display will show "ON" in this field. Otherwise, if suction float is not active, the display will show "OFF."

8.4. PAK Configuration Screens

Some (but not all) of the configuration of the MultiFlex PAK may be changed using the HHT. HHT users may change setpoints, redefine input and output type assignments, and override relays or analog/digital outputs.

HHT Changes When PAK is Connected to E2

All changes to setpoints made by the HHT are temporary if the PAK is connected to a parent E2. Changes made in the HHT do not change the configuration stored in the E2. When the HHT is unplugged from the PAK, all changes made by the HHT are overwritten by the E2, including output overrides. If you wish to make permanent changes to the MultiFlex PAK's configuration, you must make them through the E2 (or through a remote communication program connected to the E2, such as UltraSite32).

HHT Changes When PAK is Stand-Alone

If the MultiFlex PAK is operating stand-alone with no connection to an E2, the HHT is the only method that may be used to change configuration. When the HHT is unplugged from the PAK, all changes to configuration will be saved. Overrides made with the HHT, however, will be cancelled when the HHT is unplugged.

8.4.1. The PAK Configuration Menu

```
1-Gen    2-CompSP
3-Outs   4-CondSP
5-Input  6-Safety
Select: 1
```

Press F1 at any time to access the PAK Configuration Menu. To select one of the six sub-menus, press the RIGHT ARROW key, enter the number of the sub-menu you wish to access, then press DOWN ARROW key twice to access the sub-menu's first screen.

- **General** - General info about the system the PAK will control, such as number of compressors and condenser fans, the control strategy, and more.
- **CompSP** - Setpoints that determine the operation of the compressor pack.
- **Outs** - Where you select the output type for the relays and analog/digital outputs on the MultiFlex PAK.
- **CondSP** - Setpoints that determine the operation of the condenser.
- **Input** - Where you select the input type for the sixteen inputs on the MultiFlex PAK.
- **Safety** - Setpoints that determine the operating conditions for safety shutdowns.

8.4.1.1. 1 - General

Screen 1

```
   PAK Name
:PAK001

Flash  2
```

Name. Enter a name for the PAK in this field. Use the LEFT ARROW and RIGHT ARROW key to move the cursor across the name field. Use the UP ARROW and DOWN ARROW to scroll through the list of alphanumeric characters for each letter or number in the name field. When finished, press the DOWN ARROW key.

Flash. This read-only field shows the number of times the flash memory has been rewritten.

Screen 2

```
Control Strategy
Comp: Cyclic
Cond: StagedFans
```

Control Strategy Comp. This field determines the strategy the PAK will follow when activating and deactivating compressor groups. Refer to **Section 6.1.4.,** *Compressor Control Strategies* for more information.

Control Strategy Cond. This field determines the strategy the PAK will follow when activating and deactivating condenser fan groups. Refer to **Section 6.2.1.,** *Condenser Control Strategies* for more information.

Screen 3

```
Num of Steps: 6
Num of Comps: 10
Num of Cond
         Fans: 4
```

Num of Steps. If using a Fixed Steps compressor control strategy, enter the total number of steps in this field.

Num of Comps. Enter the total number of individual compressors (not compressor groups) in this field.

Num of Fans. Enter the total number of single-speed fan stages (not fan groups) in this field.

Screen 4

```
PresUnits: PSI
TempUnits: Deg C
 RefrType: R404A
SpecialCode: 0
```

PresUnits. Choose the engineering unit you wish to use for all displayed pressure values on the HHT in the PresUnits field (PSI or KPA, for kilopascals).

TempUnits. Choose the engineering unit you wish to use for all displayed temperature values on the HHT in the TempUnits field (Deg F or Deg C).

RefrType. Choose the refrigerant type used in the refrigeration system in this field.

SpecialCode. This field is used by ECT personnel for service purposes.

Screen 5

```
 Cond and Comp
InterlockEn: YES
CompProofEn: YES
(4750 Ohms)
```

Cond and Comp Interlock Enable. When this parameter is set to YES, the PAK will cycle OFF condenser fans when no compressors are ON and the discharge pressure is below the Interlock setpoint. When this parameter is set to NO, the Interlock feature is disabled and condenser fans will be operated separately from compressor groups.

Comp Proof Enable. If you are using compressor proofing, set this field to YES. Compressor proofs for the PAK are not separate inputs; they are resistive loads applied in parallel with the Discharge Temp sensors for each compressor group. The PAK interprets changes in the input's resistance as proof contact closures or openings.

8.4.1.2. 2 - Comp SP

Screen 1

```
SuctPresSP: 45.0
OutDB: 8  DB: 4
StepON Dly: 30 S
   OFF Dly: 20 S
```

SuctPresSP. The Suction Pressure Setpoint is the suction pressure the PAK will attempt to maintain during compressor pack control (disregarding suction setpoint floating).

OutDB. The Outer Deadband is the range of pressure values, equally above and below the Suction Pressure Setpoint but wider than the Suction Deadband (or DB), within which the PAK will cancel a compressor group stage change if the suction pressure is detected as returning to within the Suction Deadband. See **Section 6.1.3.,** *Compressor Group Stage Activation and Deactivation* for a complete description of this feature.

DB. The Deadband is the range of pressure values equally above and below the Suction Pressure Setpoint within which the suction pressure is considered to be acceptable. While the suction pressure input value is within this deadband value, no compressor groups will be activated or deactivated.

Step ON Delay and Step OFF Delay. The Step ON Delay is the amount of time the PAK will wait after the last compressor group activation before bringing on the next compressor group or advancing to the next fixed step.

The Step OFF Delay is the amount of time after the last compressor group deactivation before deactivating the next compressor group or moving down one fixed step.

Screen 2

```
Suct Pressure
  Min SP: 0.0
Proof ReStarts
PH: 6 Dly: 240 S
```

Suct Pressure Min SP. The Suction Pressure Minimum Setpoint is the lowest allowable suction pressure for the refrigeration system. If the suction pressure falls below this setpoint, all compressors will be turned OFF and will remain off until the suction pressure rises above the Suction Pressure setpoint.

Prf Restart Dly and Proof RestartPH. When a compressor proof registers a failure, the Proof Restart Delay is the amount of time the PAK will wait in between attempts to reset the compressor proof failure by activating the compressor. The PAK will try to reset a compressor for a maximum number of times per hour, specified in the Proof Restart PH field. After the maximum number of retries, if the compressor is still failed, the PAK will not try any further resets until the start of the next hour.

If a compressor group fails three consecutive restart attempts, a Proof Fail alarm will be generated.

Screen 3

```
 Comp HP or Amps
#1 (1 to 8)  #4
 6   6   6   6
 6   6   6   6
```

The third and fourth lines of this screen contain the eight fields that specify the HP or amperage rating of compressors #1 through #8. Line three contains the fields for #1 through #4 (left to right), and line four contains the fields for #5 through #8 (left to right).

You may enter either the compressor rating in HP or in amps, provided all compressors controlled by this PAK use the same unit (in other words, enter all compressors either as HP or as amps).

Screen 4

```
 Comp HP or Amps
#9 (9 to 16) #12
 6   6   0   0
 0   0   0   0
```

Screen 4 is the same as screen 3, except the compressor rating fields on this screen are for compressors #9 through #16.

Screen 5

```
Comp Output Grps
#1  (1 to 8)  #4
 0   0   0   0
 0   0   0   0
```

The third and fourth lines of this screen contain the eight fields that specify the compressor group assignment for compressors #1 through #8. Line three contains the fields for #1 through #4 (left to right), and line four contains the fields for #5 through #8 (left to right).

For each compressor, specify a compressor group assignment from 1-8.

Screen 6

```
Comp Output Grps
#9 (9 to 16) #12
 0   0   0   0
 0   0   0   0
```

Screen 6 is the same as screen 5, except the compressor group assignment fields on this screen are for compressors #9 through #16.

Screens 7-26

```
   Fixed Steps
CompGrp>12345678
Step#1  00000000
HP/Amps:0
```

The remaining screens under the CompSP menu option are for users of the Fixed Step method of compressor group control.

Each screen determines which compressor groups will be ON or OFF when the fixed step is active. The eight characters on the third line of the display signify the states of compressor groups 1-8. Use the RIGHT ARROW and LEFT ARROW keys to point the cursor to the character you wish to set, and then use the POINT "." key or MINUS "-" key to change the character to either "0" (signifying OFF) or "|" (signifying ON).

The HP/Amps field on this screen is read-only. It shows for reference purposes the total amount of compressor HP or amps that will be ON when this step is active.

When finished, press the DOWN ARROW key to move to the next screen, and program the next step. Repeat this process for as many fixed steps as you defined in Screen 3 under the General menu option. Leave all unused steps set to all groups OFF (00000000).

8.4.1.3. 3 - Outs

Screen 1 and 2

```
ROut1: Comp Grp1
ROut2: Comp Grp2
ROut3: Comp Grp3
ROut4: Comp Grp4
ROut5: Comp Grp5
ROut6: Comp Grp6
ROut7: Comp Grp7
ROut8: Comp Grp8
```

Screens 1 and 2 are used to assign each of the eight relay outputs on the PAK board to an output type. Refer to ***Table 4-3*** on page 12 for a list of output types and their functions.

Note that though the "VSDAnalog" and "Fan Seq" are selectable output types, these functions cannot be performed by relay outputs. Do not assign these two output types to any of the relay outputs.

Screen 3 and 4

```
AOut1: FanStage1
ActiveLevel: OFF
AOut2: FanStage2
ActiveLevel: OFF
AOut3: FanStage3
ActiveLevel: OFF
AOut4: FanStage4
ActiveLevel: OFF
```

Screens 3 and 4 are used to assign each of the four analog/digital outputs on the PAK board to an output type. Refer to ***Table 4-7*** on page 14 for a list of analog/digital output types and their functions.

If you are assigning a digital output type (i.e. any output type except VSDAnalog or Fan Seq), you must also specify which state (ON or OFF) corresponds to "active." When the ActiveLevel is set to ON, the output will be 0VDC when inactive and 8VDC when active. When the ActiveLevel is OFF, the output will be 8VDC when inactive and 0VDC when active.

Screen 5 and 6

```
 Output Ovrds
R1: NOR R2: NOR
R3: NOR R4: NOR
R5: NOR R6: NOR
 Output Ovrds
R7: NOR R8: NOR
A1: NOR A2: NOR
A3: NOR A4: NOR
```

Screens 5 and 6 are used to override the relay outputs and analog/digital outputs. The R1 through R8 fields override relays #1 through #8, and the A1 through A4 fields override analog/digital outputs #1 through #4.

To override an output, highlight it with the cursor and use the POINT "." and MINUS "-" keys to toggle the field value to either ON or OFF. To cancel an override, set the field value to NOR (no override).

Overriding A1 through A4 will set the output to the DC voltage that corresponds to the selected digital state. This is determined by the "ActiveLevel" setting for the output (set in Screens 3 and 4 under the "Outs" menu). In other words, if the ActiveLevel of the output is OFF, and you override the output to ON, the voltage will be 0VDC while in override.

All overrides initiated with the HHT are cancelled when the HHT is unplugged from the MultiFlex PAK.

Screen 7

```
Analog Fan Ovrd
      Ovrd: NO
Ovrd Volts: 10
```

Screen 7 is used to override the variable-speed condenser fan output. To initiate an override, set the Ovrd field to "YES," and specify the desired output voltage in the Ovrd Volts field.

To cancel an override, set the Ovrd field to "NO." This override is also cancelled when the HHT is unplugged from the MultiFlex PAK.

8.4.1.4. 4 - CondSP

Screen 1

```
Cond TD SP: 8.3
 DeadBand : 4.4
Fan ON Dly: 15 S
FanOFF Dly: 45 S
```

Cond TD STPT and Cond TD DeadBd. The Cond TD Setpoint is the difference between the condenser discharge temperature and ambient air temperature the PAK will attempt to maintain. When the condenser TD is higher than this setpoint, the PAK will activate fan groups. When lower than the setpoint, the PAK will deactivate fan groups.

The Cond TD Deadband is the range of differential values around the Cond TD Setpoint within which the setpoint is considered satisfied. When the TD is within the setpoint deadband, no fan groups will be activated or deactivated.

Fan ON Delay and Fan OFF Delay. The Fan ON Delay is the amount of time the TD must be above the Setpoint before turning ON a fan group. The Fan OFF Delay is the amount of time the TD must be below the Setpoint before turning OFF a fan group.

Screen 2

```
   TD Control
Pressure Limits
Disch Max: 290
Disch Min: 100
```

Disch Pres Max. If the discharge pressure rises above this setpoint, the PAK will override TD control and stage fan groups ON to bring down the discharge pressure. The Fan ON Delay will be observed as each stage is activated.

Disch Pres Min. If the discharge pressure falls below this setpoint, the PAK will override TD control and stage fan groups OFF to bring up the discharge pressure. The Fan OFF Delay will be observed as each stage is deactivated.

Screen 3

```
 TD Control Fail
  Ambient Temp
DiscPresSP: 220
  DeadBand: 4.0
```

Disch Pres SP and Disch Pres DB. The Discharge Pressure Setpoint and the Discharge Pressure Deadband will be used as the fallback setpoint and deadband if the TD calculation cannot be made due to ambient temperature sensor failure.

Screen 4

```
 TD Min Ambient
   Temp SP: 1.7
DisableInterLock
Disch Pres: 305
```

TD Min Amb Temp Min SP. The Ambient Temp Minimum Setpoint is the minimum allowable value of the ambient air temperature used in the TD calculation. If the ambient air temperature falls below this setpoint, the value of this setpoint will be used as the substitute ambient air temperature in the TD calculation.

Disable Interlock Discharge Pressure. When the discharge pressure rises above the Interlock Disable setpoint, interlock will be disabled to prevent fans being locked OFF when needed to lower the discharge temperature.

Screen 5

```
CondSpray: 330
AmbLockOut: 24
 Rtn2Nrml: 270
 Off Delay: 30 M
```

Cond Spray SP. The Condenser Spray SP controls operation of the condenser spray output. If the discharge pressure rises above the Condenser Spray Setpoint, the PAK will activate the Condenser Spray output. The output will remain active until the discharge pressure falls below the Rtn2Nrml setpoint and remains there longer than the Rtn2Nrml Time.

Amb Spray Lkout. The Ambient Spray Lockout setpoint is the ambient air temperature below which the condenser spray output will be locked OFF.

Rtn2Nrml and Off Delay. The Return To Normal setpoint is the cut-off pressure for the condenser spray. When the pressure falls below this setpoint and remains there for an amount of time equal to the Off Delay, the condenser spray output will turn OFF.

Screen 6

```
Analog Fan Setup
 Max Volts: 10.0
MinOnVolts: 2.0
Min On Pct: 20.0
```

Fan Max Volts. The Fan Max Volts is the voltage of the analog output that corresponds to the maximum VS fan speed.

Fan Min ON Volts. The Fan Min ON Volts is the voltage of the analog output that corresponds to the minimum fan speed when the VS fan is ON.

Fan Min ON Pct. The VS Min ON Pct is the minimum percentage at which the VS fan will operate when ON. When switched ON, the VS fan will begin operating at this percentage.

Screen 7

```
VSD Fan Setup
Volts/MinuteRate
  Increase: 10.0
  Decrease: 10.0
```

Volts/Minute Increase. The VS Increase Volts-per-Minute Rate is the rate, in volts per minute, that the analog output controlling the VS fan will increase when a higher fan speed is being called for.

Volts/Minute Decrease. The VS Decrease Volts-per-Minute Rate is the rate, in volts per minute, that the analog output controlling the VS fan will decrease when a lower fan speed is being called for.

Screen 8

```
VSD Fault Input
ActiveLevel: OFF
 VSD Max Output
QuietMode: 100
```

VSD Fault Active Level. The VSD Fault Active Level is the input state on the VSD Fault input that indicates a VS fault. Typically, a VS fault causes an OPEN input state. If the VS inverter closes the fault input on failure, change the value of this field to ON.

VSD Max Output Quiet Mode. This setpoint sets the maximum VS fan speed when the PAK is operating in Quiet Mode.

Screen 9

```
 Fan Seq Setup
Step Volts: 1.5
All Off  0 Volts
1st On 2.0 Volts
```

Screen 9 sets the operating parameters for the Fan Sequencer output.

The All Off field shown in this screen is read-only and is fixed at 0V. This signifies 0V will be the Fan Sequencer output voltage when all fans are called to be OFF.

The 1st On field shown in this screen is also read-only and is equal to the value of Fan MinON Volts in Screen 6. The voltage shown in this field will be the Fan Sequencer output voltage when stage 1 is called to be ON.

After the first fan stage is ON, the PAK will increase the voltage of the Fan Sequencer output by a fixed amount every time a new fan stage is to be activated. Enter the fixed voltage in the Step Volts field.

Screen 10

```
 Fan HP or Amps
#1  (1 to 8) #4
 4   4   4   4
 0   0   0   0
```

The third and fourth lines of this screen contain the eight fields that specify the HP or amperage rating of condenser fans #1 through #8. Line three contains the fields for #1 through #4 (left to right), and line four contains the fields for #5 through #8 (left to right).

You may enter either the fan motor rating in HP or in amps, provided all fans controlled by this PAK use the same unit (in other words, enter all condenser fan motor ratings either as HP or as amps).

Screen 11

```
 Fan Output Grps
#1  (1 to 8) #4
 1   1   2   2
 0   0   0   0
```

The third and fourth lines of this screen contain the eight fields that specify the condenser fan group assignment for fans #1 through #8. Line three contains the fields for #1 through #4 (left to right), and line four contains the fields for #5 through #8 (left to right).

For each condenser fan, specify a fan group assignment from 1-8.

8.4.1.5. 5 - Input

Screen 1

```
SuctXdcr: 100PSI
CompAmps: 200
CondAmps: 30
LiqDig OK: CLSD
```

Suct XDucr. Specify the size of the suction pressure transducer being used in this field. You may choose 100 lb or 200 lb.

Cond CT Amp Size and Comp CT Amp Size.

The Cond CT Amp Size and Comp CT Amp Size fields specify the size of the current transducers (in amps) measuring power consumption for the condenser and compressor pack respectively. The rating entered here should be the current value that corresponds to a 5VDC output from the current transducer.

LiqDig OK. Choose the digital state of the liquid level sensor that corresponds to "liquid level OK" in this field. Choose CLSD if the sensor is CLOSED when the liquid level is OK, or OPEN if OPEN when OK.

Screen 2

```
 Input Offsets
Suct Pres: 0.0
Disc Pres: 0.0
 Amb Temp: 0.0
```

These three fields are used to offset the values of the Suction Pressure, Discharge Pressure, and Amb1Temp inputs to correct for sensor inaccuracies. The value entered in an offset field will be added to the value as read by the sensor.

Screen 3

```
  Liquid Level
    Volts   %
Min:  0     0
Max:  5     100
```

These four fields determine how the PAK will translate the voltage of the Liquid Level input into a percentage.

Enter the minimum and maximum voltage of the sensor output in the Liq Level Min V and Liq Level Max V fields. Then, enter the percentages represented by these two voltages in the Liq Level Min and Liq Level Max fields.

Screens 4-19

```
Input Setup 1
Name: Suct Xdcr
```

The sixteen Input Setup screens are where the input types for MultiFlex PAK inputs #1 through #16 must be defined. The input types are listed and described in ***Table 4-1*** on page 9.

8.4.1.6. 6 - Safety

Screen 1

```
Safety Shutdowns
HiDisch Pres NO

  Reset All: NO
```

The read-only field "HiDisch Pres" indicates whether or not a safety shutdown due to high discharge pressure is active ("YES" indicates an active shutdown).

If HiDisch Pres is "YES," the safety shutdown may be reset from this screen. Move the cursor to the Reset All field and press POINT "." or MINUS "-" to change the value of the field to "YES."

Screen 2

```
Disch Trip: 340
Reset Diff: 50
Reset Delay: 15M
  Resets PH: 5
```

Disch Trip. The Discharge Trip setpoint is the discharge pressure value that, if exceeded by the Discharge Xducer input value, will cause a safety shutdown of the refrigeration system.

Reset Diff. When a safety shutdown due to discharge trip occurs, the Reset Diff is the amount the discharge pressure must fall below the Discharge Trip setpoint before the PAK will automatically reset the safety shutdown and resume normal control. In other words, if the Discharge Trip setpoint is 340 PSI and the Reset Diff is set to 50, a safety shutdown will be reset when the discharge pressure falls below 290 PSI (340 - 50).

An automatic reset will only occur if the PAK has been in safety shutdown for an amount of time equal to the Reset Delay.

Reset Delay. The Reset Delay is the minimum amount of time the PAK will remain in safety shutdown after a discharge trip has occurred. After the Reset Delay has elapsed, if the discharge pressure lowers to below the Discharge Trip Setpoint minus the Reset Diff, the safety shutdown will be reset and the PAK will resume normal control.

Resets PH. The Resets Per Hour field specifies the maximum number of automatic resets of a safety shutdown that will be allowed within a one-hour period. If a safety shutdown occurs and the PAK has already auto-reset a number of times equal to this parameter in the past hour, the PAK will not attempt another auto-reset and will remain in safety shutdown for the remainder of the one-hour period or until the user manually resets the PAK (see Screen 1 under the "Safety" sub-menu).